THE LURE OF THE LAND

HARVEY W. WILEY

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The Loudoun Valley as seen from Mount Weather. Dr. Wiley's farm includes the long forest area in the front of the picture

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FARMING AFTER FIFTY

BY

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To the memory of my

FATHER AND MOTHER

pioneers of the backwoods of Southern Indiana, who taught me the homely duties of cultivating the fields they rescued from the forest, reverence for truth and to battle for the right, and illustrated by their example the dignity of labor in a hard environment,—

I dedicate this book.

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Rura laudamus meritò poetae
Rure floremus; dominoque laurum
Sole gaudentem necat oppidorum
Nubilus aer.

A. Couleius.

THE LURE OF THE LAND

I

THE LURE OF THE LAND

IT is not my purpose to discuss problems of life in the country for those whose incomes permit them to follow any desire or whim that may possess them. The lure of the land to which I refer is not that of the speculator; nor of the miser, who would increase his landed possessions as he would his gold; nor of the promoter, whose desire for the country is to lay it off in lots and sell it to his fellows; nor of the exploiter, who loves to possess only that he may rob and degrade. From my point of view I would set forth for the average man of average means, who wishes to indulge the natural desire for country life, the dangers and difficulties, as well as the advantages and successes, of making his home on the farm.

It is evident that those who live in the country must earn a living, but in doing this there is no need that all of the beauties of rural life should be sacrificed until it becomes a burden unbearable. It is not difficult to understand how the youth brought up on a farm turns his longing eyes towards the town. The conditions of farm life, as a rule, are not such as to attract or to hold the farmer's son or daughter. Life does not consist alone in watching the beautiful sunrise, in strolling through a shady forest, or wandering by a babbling brook. To the farmer's boy life means early rising, hard and continuous labor, plain and often poorly cooked food, hard beds, and an absence of all the opportunities which the youth so strongly desires. It is just as natural for the farmer's boy to look towards the town as it is for the town boy to look towards the country, but these conflicting desires arise from different sources.

To the farmer's boy the town appeals as a means of a career. The country appeals to the city boy as a place of rest and quiet enjoyment. When you turn your face towards the city you go to hard struggle, a hard environment, to a life surrounded by temptations. When you face the country, on the contrary, you look to a life of repose, of quiet, not devoid of labor, but with greater certainty of success and less ignominy of failure. The one is an instinct to return to the natural life, the other is a desire to acquire the artificial life. Each of them is logical, and each of these desires must be reckoned with from the standpoint of practical philosophy.

The point that I wish to make is this: When should the city man yield to his desire to go to the country? I would not in any way seek to diminish the intensity of this desire, but I think it wise to do something to help control it and to set forth the facts of the case in some way which may be beneficial to the man who tires, as every good man should tire, of city life. The number of those who are able to go to the country and found large estates, build fine houses and drive fine horses, is extremely limited. On the other hand, the number of men in very moderate circumstances who would love to yield to the longing for out-of-door life is immensely large. Before indulging this desire, however, some practical points are worthy of consideration.

In the first place, the lure of the land, even in mature persons, is apt to lose its pull when brought up against the hard conditions of country life. The person who thinks of going to the country, therefore, should be perfectly certain that he really wants to go. It may be he is longing only for a vacation, and in this case in a few weeks or months, or at most years, he will tire of his vacation and desire to return to the old conditions. It is most unfortunate, in a case like this, that he should have so disposed of his fortune as to make it practically impossible to get away from the country with which he once was so enamored.

There is a large number of city men,— and it is mostly among the men that this desire obtains,— who have achieved respectable careers as teachers, as employees in business houses, as physicians, as lawyers, as ministers, as business men, whose eyes are turning towards the country. Should they yield to this temptation, or should they stay where they are making a respectable living and deporting themselves as respectable citizens? The answer to this question, of course, cannot be a general one. It all depends. First of all, the wife and daughters should be consulted. While the husband and father may desire to go to the country, the wife and daughter may not. The venture is certain to be a failure unless all parties are agreed upon its desirability. The titular head of the house, therefore, should never lose his heart to the lure of the land until he is certain that the wife and the daughter, and the son too, for that matter, are of the same mind. A mere sojourn of a week, or a month, as boarders at a farmhouse is by no means sufficient to determine this point. Many a wreck has been the result of taking the family to the country, and afterwards having part or all of it become thoroughly dissatisfied. There are so many rough realities in a life of this kind that it takes the poetry out of the visions of joy, peace, contentment and success, that arise in the minds of many.

There are thousands of people to-day, however, to whom the question is one of immense importance. The longer a man thinks about it, the more infatuated he becomes with the idea. He must, therefore, lay aside prejudice and desire, and look at the matter in the full light of practicality. The landscape is apt to lose its beauty after a few hours in the harvest field, and the forest is valued only for its shade after ten hours' plowing in the hot sun. The problems which are to be considered are many, and only a few can be presented in this work. As one who knew all about farm life as a boy and has had a pretty large experience with it as a man, and who has returned to it in the late afternoon of his life, I may perhaps be able, from my experience, to say a few things that will be helpful.

My object is not to keep farmers' sons and daughters at home, so much as it is to keep fathers and mothers who have no business in the country from going there. Better by far to stay in the city, where the environment is known and where the niche into which you are thrust is more or less adapted to hold you, than to come to grief through a mistaken idea of what is necessary to successful farming.

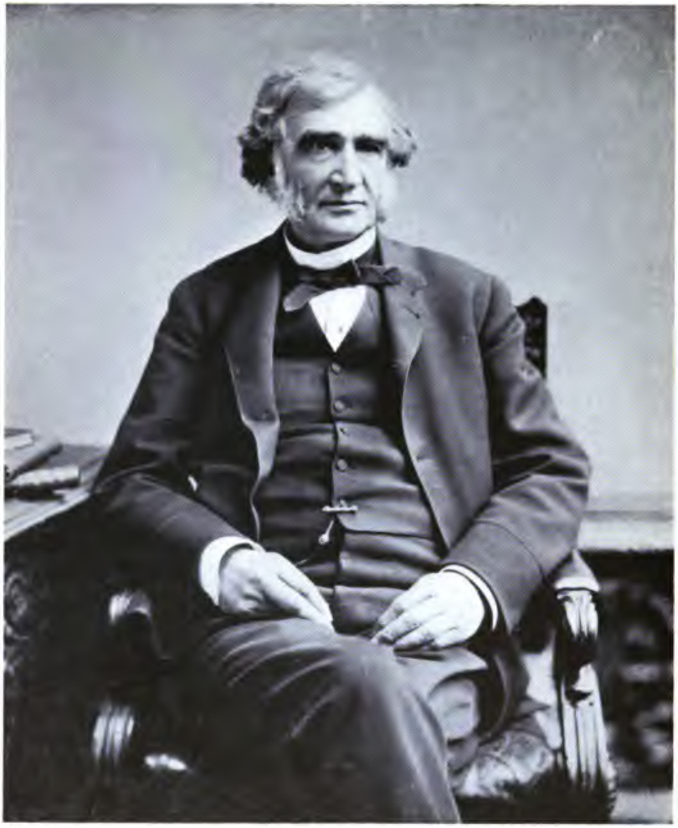
The difficulty of the problem is increased by reason of the artificial life of the present time. Every day the urban population seems to grow larger and the rural population to diminish. It is a rare thing for an intelligent and ambitious farmer's boy to become a farmer, or for a well educated and brilliant girl to marry a farmer, not because such things should not be, but because the expectation of success and happiness in life is not at the present time in any particular way associated with country life. Nor am I foolish enough to suppose that the cities are going to be depopulated. Much as that is to be desired, it is not likely to happen. On the other hand, we must calmly look forward to an increasing density of the urban population and a smaller percentage left in the country. While I try to look at the matter from a philosophical point of view, I realize the almost hopeless effort of trying to depopulate the city. I shall have something particular to say upon that point further on. My purpose, therefore, is not to change the existing order of things, but to try to make the best of it.

Much is to be expected from changes in the studies of our country schools. The ideas of country life imparted to the school children in the city should be no longer colored nor painted. The truth should always be told. It is well to imbue the city child with a love of rural life, but it would be wrong to imbue him with a love of this kind and to leave him in ignorance of the hard conditions which it imposes. I have had many applications from city boys to spend their summers with me on the farm, and have had a little experience of that kind. How quickly the glamour of the country wears away from the city boy when he goes out to work in the fields! The hard labor of the hot day soon removes the last vestige of enthusiasm, and it takes a boy of fine spirit and splendid mettle to stick to his job.

Again, the wickedness on the part of promoters in seeking to sell to city people suburban properties should be pointed out. As I read their advertisements I cannot help thinking, "How many suckers will bite at this bait!" As a rule, the most unhappy man you meet is the so-called suburbanite. When you can see him through the bundles he carries to and fro, you do not always detect the countenance of the happy. The suburbanite's family expects to live as people live in the city. There must be servants to do the work, prepare the food and sweep the floors, and the best of the city market must be brought. No wonder the man who goes back and forth to his business soon finds life a burden!

While I agree that it is better for the individual to have a country home, accessible by trolley or otherwise, and still to do business in the city, his lot is not the one which I am to portray. The man I have in view is the one who not only goes to the country but, after investing his little hoard of a lifetime, expects to make his living for the rest of his life from the farm on which he is settled. My observation is that it is rare for a man who has devoted his more active life to other pursuits in the city, to become a successful farmer; I mean by that to live from the products of his farm. Thus at the very outset I may say to those who are suffering from the disease which I call ruralitis, that the expected living which is to come from a farm is to a large extent visionary.

At the same time I would be sorry to see this love of rural life less regnant than it is. Theoretically, my idea of humanity would be a scattered population, all of the productive industries taken out of the cities and placed in the country to which they properly belong, and the city left only as a place of exchange. Meanwhile, let us make the best of things as they are. The suburban life should be encouraged because it has some



SENATOR JUSTIN S. MORRILL
Father of the Land Grant Colleges

points of superiority. At least in the suburbs you can have a house with the light and air of heaven all around it, and if it is beautiful, as sometimes it may be, its beauty will not be confined to the front door, as is the case in the city. The suburbanite can have his yard and his garden, even, though he may have to hire their care. He has light and air, he has opportunity for his children to place their feet upon the ground, and he does not have a saloon at every corner of his yard. He should be schooled beforehand, however, to bear the burdens becomingly and to know that even in the suburbs life is not one long dream of happiness.

But most of all I would speak for those who intend to be real farmers, to live upon the farm and gain their livelihood therefrom,— and by farm I do not mean simply fields of wheat and corn, but I mean orchards and dairies and gardens and forests, in fact all the various activities by means of which Mother Earth yields her treasures of grain and fruit and flowers to her tenants. Hard as the life is, full of unexpected difficulties, accidents and discouragements, one should not be always deterred from trying it. And so I would speak the truth about farm life and call attention to some of its difficulties, and warn the man who feels the lure of the land in his heart against possible disasters.

At the same time, I would extend the right hand of fellowship to those who come. I would teach them the philosophy of patience, the dignity of labor, the splendor of producing something that is of real value and not merely an exchanging of values with the hope of a "commission," and instil into their minds the philosophy of living as near to nature as possible. Then if they follow the natural impulse, they will not suffer such grievous disappointments, nor magnify disasters, nor falter in their faith in the midst of difficulties. They will be able to build up, in the sunlight and the air of heaven, a real home of comfort founded upon labor, and of happiness and contentment of a purely natural character.

II

AGRICULTURE A LEARNED PROFESSION

TO the city man, even if his boyhood was spent in the country, farming is an unskilled profession. In other words, anybody can be a farmer. If a farmer should have a number of sons differing in mental capacity, he probably would take the one who had the gift of speech for the purpose of making of him a preacher or a lawyer, the one who believed in research might be a scientist or a physician, while the one who seemed to have no particular ability for anything would be selected to stay upon the farm. If the facts of farming were properly appreciated, quite a different attitude would be manifested. The brightest and best of the boys by all means should be kept upon the farm. It is a fundamental error to suppose that farming is neither a business nor a profession. It is a business which requires the highest business talent, it is a profession which requires the best technical skill. It is true that farming perhaps embraces a larger percentage of unskilled men than any other profession, but that is not the fault of farming itself. There is no other profession that requires such a variety of learning, such an insight into nature, such skill of a technical kind in order to be successful, as the profession of farming. That this is recognized as a fact may be easily shown by a few commonly recognized truths.

All over the world schools of agriculture are multiplying. A hundred years ago there was no such thing as an agricultural school, the agricultural experiment station was unknown. A lot of facts had been accumulated by experience, but these facts were not correlated nor put into any kind of a systematic form or shape. The man without brains, provided he had hands and muscle, was considered the ideal farmer. How much that has changed one needs only to look around him to see!

That great statesman, Senator Morrill of Vermont, was one of the first of our public men to realize the importance of farming as a profession. During the throes of the Civil War, when it was uncertain whether or not the nation would survive, Senator Morrill took the stand that he believed the nation would survive and in its survival would depend upon its agriculture for its wealth and progress. In 1862 he saw enacted into law his bill introduced into Congress to establish agricultural colleges in all the States. To this end he provided that the United States grant a portion of its public lands for this purpose. In the older States there were no public lands, therefore he devised a scheme of opening the vast domain of the West not only to actual settlers, but also to preëmption by the States. A certain number of acres of land was set aside for each State, in proportion to the number of representatives and senators it had in Congress. Thus the old States, such as New York and Massachusetts, would have the same opportunity to have the benefit of this great grant as the new States and territories where the lands were situated.

When this proposal of Senator Morrill became a law, very little was thought of its value and brilliant future. The States themselves were slow to appreciate it. They came into possession of what was called land script, that is, orders on the public domain in any locality where preëmption had not already taken place. As it is possible to divide men into wise and foolish, so it was soon possible to divide the States into wise and foolish. Some of the States, notably New York, located their land script and kept the land, which of course has increased immensely in value. Others, and among them my own State, Indiana, sold their orders on the public domain at a fabulously low price. Indiana had, in round numbers, nine hundred thousand acres of public land assigned to it for purposes of agricultural instruction, not excluding the mechanical arts and military tactics. This vast amount of script was sold for less than four hundred thousand dollars, in other words less than fifty cents per acre. What a mine of wealth the State would have possessed had it located its lands and kept them for leasing purposes! Probably to-day the annual income of the State from this source would have been greater than the whole of the money received for the sale of the land.

But in spite of the wastefulness with which these grants were handled, the purpose for which they were made has been realized. In every State and territory of the Union to-day there is an agricultural school, which also teaches the mechanical arts and military tactics in harmony with the law of Congress, and these schools are all endowed, partially or fully, by the proceeds of the land given under the Morrill act. In some States the fund has been divided, so that there is more than one college. This is the case especially in some of the Southern States, where a college has been established both for whites and blacks. It is difficult to estimate to-day the total income in the interest of agriculture and technical education which arises from the benefits of the Morrill act.

The States have also given additional sums for the support of these institutions. Later additions were made to the grants of funds from the public treasury in the interest of agricultural education. Among the first of these was the Hatch act, establishing particularly agricultural experiment stations.

Wonderful as is this endowment, the greatest ever given to education by any nation or at any period of history, the progress of agricultural training has not been limited alone to the colleges and experiment stations. Forty years ago the Farmers' Institute was almost unknown. To-day hundreds of institutes are held throughout the whole country, in which the data relating to agricultural progress are presented and discussed. I well remember my first appearance at a Farmers' Institute, now nearly forty years ago, as a young teacher of agricultural chemistry. I was expected to tell the farmers something about the principles of fertility. It was an embarrassing situation to me, having only lately come into this work and being so little acquainted with all of its ramifications. Fortunately for my reputation, my audience knew even less than I. The terms "phosphorus," "potash" and "nitrogen," were indeed Greek to the farmer as most of them were Greek in their etymology. But at least there was an awakening among them. It was the dawn of a new era in Agriculture.

If we could only compare this primitive institute in Indiana with one of its modern descendants, what a contrast there would be! From my point of view the institute was a great deal more of a school to me than it was to the farmers who came. I realized then, at the beginning of my professional life, the magnificent problem of agricultural science, and although I have devoted much of my life to the study of that problem, I realize to-day how utterly unsolved it still is.

Many years ago, when the scientific sun was just rising on the general farmer, I tried to put some of these ideas into rime. My purpose was to portray, if possible, the ideas which were planted in the mind of the old farmer when he first attended the Farmers' Institute. These rimes run as follows:

FARMER JOHNSON RELATES HIS IMPRESSIONS OF THE "INSTITOOT."[1]

You seen the notice, William, of the meetin' up to town,
Of the farmers in the Institoot, they come from all aroun'.
There wuz Billy Woods from Haw Patch, and old Sam Mapes from Hope,
And Peter Hughes and Barney Flinn and Tecumseh Sherman Swope.

And half the town from Taylorsville, and you had orter seen
Judge Edgington a mixin' round amongst us playin' green.
And Lawyer Sims wuz also there, you see it seems ez how
He's up for the ligislatur and wants to larn to plow.

And the fellers from the College of Agricultur, they
Wuz thick ez lightning bugs in June and had a heap to say.
Ther wuz one they called a chemist, and he kind a seemed to know
All that wuz in the air above and in the ground below.

He sed we needed nitergin, and showed us how the stuff
Wuz awful high and skeerce for crops, while in the air enough
Wuz found to make us 'tarnal rich if we could only git
Some cheap and sarten projeck of hitchin' on to hit.

He sed that peas and clover and other crops like them,
Wuz jist the stuff to do it and store it in the stem,

[1] "Songs of Official Agricultural Chemists," Washington, 1890.

And the yearth is full of critters that eat this stuff you see,
And change it in a twinkle into ammoniee.

That arternoon the sheriff he as't us out to see
Some Jerseys in his pastur; the prof. he rode by me,
We crossed the crick at Haskell's and passed the clover field
Whar he hed wheat last summer with sich a bustin' yield.

The professor he wuz lookin' and when the field he spied,
"Them taters 're lookin' splendid fur the time o' year," he cried.
"Them ain't taters," said I, laffin'; "why, professor, don't you know
Thet 's the clover which you told us would give us sich a show?"

Sence I come back from the Institoot it really appears
Thet potash, nitrate, phosphorus, wuz ringin' in my ears,
And, William, it seems purty tough thet you and Jim and me
Have went along so ign'rant of what we daily see.

Jist hauled manure out on the pints and plowed and hoed and mowed,
And worked so hard for little pay, and never, never knowed
Thet clover, peas, and beans, and sich ez the chemist mentioned there,
Hev the highly useful knack of suckin' niter from the air.

Having retired now for several years from addressing farmers' institutes, I would be almost afraid again to attempt it, so wise and critical have the farmers become on all the points relating to the scientific exposition of the principles which underlie their profession.

Not only have the farmers' institutes done this wonderful service, but they are not the only avenues of progress. We have now throughout the country agricultural trains passing rapidly from county to county, carrying a corps of learned and practical men, with coaches filled with exhibits and charts of instruction, thus bringing to the very doors of the farmer who is

"THE CHILDREN WILL NOT GET TO COLLEGE UNLESS I SHOULD FIND A CHANCE TO SELL"

I PULLED UP AN ACRE OF PEACH ORCHARD AND SOWED ALFALFA

unable to attend the agricultural college or visit the experiment station, the best fruits of their activities.

Finally, there has come to the aid of the instruction in agriculture the moving pictures, showing the varieties of farm life and the methods of overcoming its mechanical difficulties, illustrating the tillage of the soil, the growth of the crops and the activities and peculiarities of farm animals, the wonderful intelligence and technique of the honey bee, and so on through the list.

I doubt if there is any other branch of knowledge today which has a larger endowment, more competent corps of teachers, more enthusiastic pupils, than the great university of agriculture, which exists in all of the manifold forms which I have described throughout the length and breadth of the land. The United States is by no means the only country in which it is recognized that farming is a learned profession. In Europe and in the islands and continents of the seas, and even in Asia and Africa, the elucidation of the fundamental principles of agriculture is constantly carried on. Professors and tutors and artists and mechanics and photographers and illustrators are carrying this new propaganda throughout the world.

III

THE BOOMERS AND THE BOOMEES

THE city man of small means who has acquired a passion for the country is picked out as an easy mark by the boomers who have attractive (on paper) orchards, gardens and farms to sell. The "boom" perhaps may take the form of a poultry campaign, and some of the older readers may remember the epidemic of "hen fever" that spread over the country forty or fifty years ago.

There is the same principle underlying all exploitations of this kind: first, the skilful and insidious play upon the human desire, and the attractive and deceptive form in which that desire may be gratified. The typical promoter is by no means devoid of intellect; in point of fact, he is shrewd, keen, intelligent and conscienceless. He is, above everything else, a profound student of psychology. He knows to the uttermost limit the moods and passions of man. He plays upon them skilfully, as the virtuoso touches the keys of the piano.

A story is told of an event which took place at a meeting of the makers of automobiles. At this meeting the various proprietors or manufacturers of the different motor cars had the opportunity of freely advertising their own special brands. One of the largest of the makers, while on the floor, described the wonderful scope of his business. He said, "You scarcely realize the magnitude of the business which I represent, and perhaps a simple illustration will suffice. We make and sell a complete car every two minutes." The manufacturer who followed him did not fail to take advantage of the opening. He remarked, "The business of the gentleman who preceded me is undoubtedly of great magnitude, and well illustrated by what he said. The business of the gentleman is, however, not nearly so great as it ought to be. He should be ashamed of not having improved all of his opportunities. He told us that he made and sold a motor car every two minutes — he should remember that a sucker is born every minute."

Unfortunately all of these suckers are not buying motor cars. Hundreds and thousands of them are investing in orchards, in gardens and in lands. In the past few years there has been a remarkable revival of land speculation, and many thousands of the citizens of our country have bought and paid for impossible or inaccessible fields and gardens. Especially was this illustrated in the fever which spread over the country for purchasing the Florida everglades. These lands were presented in such an attractive manner that it was impossible to believe that any person investing in them could fail to make a fortune, and that speedily. Visions of orange trees and luscious grape fruits and the less hardy lemon were dangled before the eyes of the hypnotized investor, who could even scent the odor of the flowers and see the glory of the wild orchids in the nearby forests. In so far as the alligator and the rattlesnake were concerned, they almost ceased to exist; but enough of them were left for the attractive pocketbook and traveling bag. The salubrity of the climate was painted in such colors as to make it no wonder that Ponce de Leon sought for the waters of eternal youth in this floral paradise.

In point of fact, however, this beautiful country, so artfully and ingeniously portrayed, was principally under water, leading one of the members of Congress, in referring to the matter in a speech upon the floor of the house, to remark that it was "a shame to sell those lands by the acre, they should be sold by the gallon."

Even the officials of the Department of Agriculture were drawn into the controversy in a way not at all to the credit of some of them. Publications telling the truth about these lands were suppressed, and other publications, coloring gorgeously the attractiveness of the everglades, were permitted to be distributed. The engineer who had stuck to the truth and told it, was discharged on a trumped up allegation of having misappropriated public funds. He was even prosecuted before the grand jury and indicted for this offense, only to have the indictment quashed and to be restored to his position when all the facts of the case were known.

Old soldiers were especially invited to spend their last days in a land where frost did not corrupt, nor mosquitoes break through and squeal. Impecunious clerks in the departments were induced to invest their hard earned dollars, which they so much needed for the necessities of life, in these visionary dreams of agricultural wealth.

My own name was used very extensively by the promoters of these schemes, without my consent and against my positive requests to the contrary, and it was necessary even to threaten the users with legal proceedings before my name was withdrawn.

No less deceptive and insistent were the advertisements of the wonderful profits to be made from orchards, especially in the States of Washington, Oregon, Colorado, Idaho and Montana. Even the nearby Virginias were exploited. Wonderful offers were made to intending investors: their orchards would be planted and cared for for five years at a charge included in the purchase price, and then all they would have to do would be to live forever on the wonderful income which would be secured. Stories of the realization of five hundred or one thousand dollars per acre, or even more, were scattered abroad to inflame the desire and obscure the judgment of persons with small means.

The number of well intentioned persons who, having accumulated a few thousand dollars, were led to sacrifice it all and to be brought to the door of starvation in their old age, would be phenomenally large if all the names of the victims could be collected. Unfortunately those who have lost everything in ventures of this kind are prone to keep the matter quiet, while an investor who has made money announces it with trumpets from the housetops.

The irrigable lands also are largely in the same category. Every possible town site in the desert was preempted by promoters who relied upon sales of the desert lands to secure the funds for development. The remarkable work which is being done in the reclamation service, winning thousands of acres of land from the desert to the garden, becomes the basis of a campaign to induce intending investors to buy these irrigated lands long before a drop of water is in sight. Even where water was available, the conditions which prevailed were so distorted as to lead to the investment of the little all of the new farmer in a manner whereby absolute failure was inevitable. It would be interesting if the personal stories of these deceptions could be widely distributed, but, as a rule, those who have suffered and become the innocent victims of these propagandas of promotion, are unwilling to have their names appear in print.

It is the old story of the gold mine over and over again. Perhaps as long as humanity remains as it is, the art of the deceiver will flourish. The same principle which permits huge fortunes to accumulate by the sale of quack remedies and worthless nostrums, is the one employed to separate the hard-earned money of the people and pour it into the coffers of the wicked promoter. It is one of the astounding facts of humanity — to realize the truth of the fundamental principle of Barnum's career,— namely, that the people love to be humbugged. It is not quite so bad when this humbuggery extends simply to going to a show. And after all Barnum was not so great a humbug as he claimed to be, because he gave a really interesting and instructive performance.

From the financial point of view, also, the victim of the quack remedy is not so much to be pitied, because it is only occasionally that he invests all he has in a worthless remedy. Usually the promoter is wise enough not to reduce him to penury, because that would take him out of the ranks of his patrons. The wilder the theory, it appears to me, the more devoted the convert. Vagaries in politics, and especially in religion, are quite as pronounced as those in medicine, and in gold mines, and in submerged farms and non-existent orchards.

This Satanic cult even goes to the extent of defrauding the people in the matter of the foods they use. Simple cereals, the cost of which is perhaps not to exceed one and one-half cents a pound, are put up in attractive packages under fine sounding names and sold to the consumer at profits of from 300 to 3,000 per cent. All along the line of battle are found the camp followers who exploit human credulity and weakness and hypnotize and rob. We are hardly happy without our daily deception in some form or other. Those who have the love of agriculture, however, should be particularly on their guard against all such seductive allurements. I can assure you all that there is no quick road to wealth along the agricultural line. What little you may be able to earn will come from much labor and much sweating, not to count the worry and the disappointment.

A man would hardly expect to gain a large living by investing two or three thousand dollars. The average income of an investment in this country is probably not over five per cent. of the invested capital. One thousand dollars, therefore, cannot be expected to earn more than fifty dollars. If, however, you add to the investment your own personal labor, the return should be larger. The man who works in the field every work-day for a year has close to two hundred and seventy-five days of labor. That ought to be worth to him at least two hundred and seventy-five dollars, and if he has one thousand dollars invested in his farm he ought to earn five per cent. on the investment and pay himself almost three hundred dollars for his labor. In sober consideration of the problem that is all that any one may hope to have by investing one thousand dollars in ordinary farm land. This income, too, means hard work and careful attention.

AN ORCHARD EXPERIENCE IN COLORADO.

I am giving an experience in a Colorado orchard mostly in the language of the college professor who left his position, attracted by the allurements of the orchard business, to cast his fortunes two thousand miles away from his former home in the new land of Eldorado. He says:

If I should give my experiences year by year I might seem to be a "knocker." No one likes to appear in that light. Many have done better than I, and, also, some have fared worse.

It was very difficult for me to decide to buy because of high prices of land. I held off for some two months and looked the country over tolerably thoroughly and talked to all I met. I believe that if we had had as few disastrous years as old timers all declared had visited here within the twenty years before our coming, we should have made good, even at prices then prevailing. We bought twenty acres, paying approximately $800 an acre for the portion, 7½ acres, in bearing apple trees, and $400 an acre for the 12½ acres which was partly set with young trees and in alfalfa and partly in prune trees.

We got the crop on the trees the summer we bought, that is, the summer of 1905. It was a good crop and brought a fair price. Since then we have had only two years as good. There have been frosts and freezes in the spring, or wind and hail in summer, or snow and hail and freezing weather in the fall before we got the crop harvested.

In 1910 we sold the bearing apple orchard, 7½ acres, for $6500, and paid off our notes and had the 12½ acres clear. In 1909 we had a good peach year. Our orchard netted us about $150 an acre that season. In the other years it has not paid expenses. In the fall of 1912 I pulled up one acre of peach trees and sowed the ground with alfalfa. I expect to pull out one acre more this fall. That will leave me two acres of peach trees.

The most disastrous year this valley ever saw was 1912. We had bumper crops of both peaches and apples. But the summer was cool and showery and the peaches were late. I had just begun picking when there came a snow storm. The snow lay on the peaches for a day. The trees were already breaking with fruit. The additional weight broke many limbs, and some trees were ruined. The snow was followed by frosts,

INCONVENIENCES OF LIFE
In old-fashioned farm-houses these reached their limit

which spoiled at night the peaches which had ripened during the day. To cap the climax, the market was full and our stuff brought no price. Most of the peaches were allowed to fall to the ground. We had about 4000 boxes go on to the ground, and marketed only some 600 boxes.

I had spent money in the summer thinning peaches, buying ladders and box stock and wrapping paper. All in the neighborhood did the same. Many built packing sheds. The apple crop did not help much, for the country was stuffed with apples and our stuff brought very low prices. The money for fruit did not get to the grower until the following summer.

The winter of 1912-1913 was the severest since any government record has been kept, and many peach trees were killed. Some whole orchards were lost. Since that year many mortgages have been foreclosed. In the fall of 1912 I had to borrow $1000 on account of the freeze and low prices, and had to mortgage the place. The cold winter of 1912-1913 froze the peach trees, and so we had no peaches last season. I had some 300 boxes of fine apples on the young trees in the fall of 1913, but the very day I had set to pick them there came the worst hail storm I ever saw. In five minutes the crop was punk.

This spring looks good so far, but I have learned not to be puffed up. I am not counting the money for the crop, nor thinking of ways to spend it. When I get the money I'll have it, and that's all there is to it. But in spite of all this we have not suffered from hunger, though we fare mighty plainly. I live on bread and milk most all the time. Luxuries we have none, excepting the scenery. That can scarcely be excelled.

I never saw the apple orchards look finer than they have this year, but "What shall the harvest be?" The year we came here a banker in town told me he did not know of a case of foreclosure of mortgage in this valley. Since 1912 there have been dozens of foreclosures, and there are more to follow soon. Those who came here in early times — twenty years ago — and got the land cheap and have their homes clear and own good bearing apple orchards, are safe. They can stand any number of bumps. We have some such neighbors.

The people here are unusually well educated and well read for farmers. There are many ex-school teachers, school superintendents, college graduates, hard-headed Germans and Quakers, and others from Iowa, Missouri, Indiana, Illinois, Massachusetts, New York, and from all parts. After the readjustment the country will recover. It is a good country but over-boomed. People are now turning attention somewhat to poultry, pigs, sheep, alfalfa, beets, et cetera. We were tree crazy for a time, but are getting more sane.

Now is a good time to invest here. I know several bargains. Never till last year did I advise any one to buy. Mr. W. H. and wife visited us last summer. They live in Indianapolis. I advised them to buy our place and they came near doing so. If I had $5000 or $25,000, I would invest it here now. One neighbor who has some 30 acres of nice orchard says it is still worth $1000 an acre. They do not wish to sell.

Apple raising is not such a "gamble" as peach raising. By building a store-house and putting the apples there as they are picked, one can take time to pack and sell them. One can learn something of market conditions. If the prices do not warrant shipping them hold them for better prices, or let them rot at home and save paying expenses of packing and shipping.

I invested all I had and borrowed more. I am in debt. I do not expect ever to get out. The children will not get to college, unless I should find a chance to sell and go East and buy a small place near a college town. We are cramped. Sometimes I feel like running away and letting the place go, but that would hardly do. I'd like more room. Could have done better on a general farm. I understood that business; this I had to learn. Prunes were of no account. I pulled out the prunes and set apples. Poor lot of trees. Did no good, not true to name. Had to graft and bud and reset and reset and reset every spring.

I fear I cannot give you a true notion of things in a letter. I might in a pamphlet! It would take a week to tell you what is needed to understand all. But it is surely true that the booming has been overdone. Real estate agents are most to blame, I think. They are good fellows to shun when buying property out here.

It is true that occasionally a man invests in a gold mine and makes a fortune. There is such a lucky thing as investing in land and making a fortune. This fortune, however, does not usually come the agricultural way. You may acquire a piece of land where the future city will stand; you may get land at a cheap rate and the development of the country round about you will rapidly increase its value; coal oil or gas may be found underneath, but these chances are much less common now than formerly. Towns are pretty well located in this country, railroad building is not very vigorously pushed, new towns that amount to anything are rare; and the man who places his hope of a fortune, when he invests in land, in the development of a new town, is hanging his future on a very fragile thread.

My advice to intending investors is to keep carefully away from investing in any boom advertised scheme. I would not say that they are all bad, but I never yet have seen an advertisement of a land scheme that wasn't grossly exaggerated. All the things that make for difficulty and labor are concealed, while the possibilities of income are enormously distorted to gigantic proportions. The best place to invest is a place that you know. Don't go so far from your base as to lose your line of supplies. Better get a poor piece of land nearby where you know the market and the people, than to take the risk of a very fertile piece of the same size three thousand miles off. If I am to make my living on sand, I would rather get a field on Long Island than to have a section of sand in Florida. Oranges and apples come with tribulation and much labor.

All is not gold that is yellow, and this is particularly true of the citrus fruits. All is not silver that has a sheen and this is particularly true of the gorgeously colored apple. The stories of profit in agriculture should be subjected to the corrections of rigid criticism.

IV

THE BORN-ON-THE-FARM MYTH

IT is a very common custom, especially with those who seek political favors, to impress upon the electors the importance of the fact that the particular candidate in question was born on a farm. It certainly is no disgrace to have been born upon a farm, nor is there any excuse for boasting of it. In so far as the child is concerned, the birthplace is peculiarly accidental. Important as heredity is, the child has no choice in the matter, he cannot choose either his father or his mother. Important as environment is, the new born child is equally the creature of fate, he cannot choose whether he shall be born in a hovel or a palace.

This pleasing fiction, which is so sweet under the tongue of the politician, is a mute tribute to the importance of rural birth. As a means of political preferment it is harmless, and at most creates only a smile in informed auditors. In some respects, however, being born on a farm is a positive disadvantage. As a rule, this is the case with the man who wants to be a farmer, especially in his mature years. Old-fashioned farming in this country has not much to boast of from a scientific point of view. There was plenty of hard work, quite enough getting up at four o'clock in the winter morning to milk the cows, exposed during the night to the inclemency of the season, quite enough of the unscientific methods of feeding the farm animals, which was done without rime or reason, and quite enough of the toleration of the inconveniences of life, which in old-fashioned farm-houses undoubtedly reached their maximum.

As a rule, I may say with certainty that the man who was born on the farm and lived on the farm until manhood, and afterwards has pursued some other career until the advent of the last period of life, suffers a distinct disadvantage and handicap from his early experiences. The only hope of the new farmer who begins his career of agriculture after the maturity of his years, is in adopting the latest scientific methods of culture. I cannot agree with the theory that successful farming in this country will come from *extensive* instead of *intensive* culture. This theory, in effect, is that intensive farming is expensive farming and extensive farming is economical farming. The first part of this statement is undoubtedly true, but in the light of modern progress in agriculture we must take exception to the latter part of it. A more correct statement would be as follows: "Intensive farming is expensive farming, extensive farming is robbery."

The point which I want to bring out clearly is this, that the man of to-day, born on a farm, who, at fifty or sixty years of age, thinks of abandoning the professional career to which he has been devoted since manhood, by reason of his longing to return to the farm, has had no real experience in scientific farming during his boyhood. The chances are one hundred to one that he was taught *extensive* farming, in other words agricultural highway robbery.

Extensive farming means to cultivate as much as possible and pay little attention to the feeding of the fields. The extensive farmer would very probably take all of his horses at the beginning of the plowing season and keep them at the plow for twelve hours a day, and feed them by turning them out to pasture at night. Apparently he would be getting very economical service; in reality he would be destroying his motive power. For this reason the man born on the farm is likely to begin his new farming career with the handicap of the bad training he has already had.

Proud of the fact of his early experience, he will doubtless proceed again to put it into practice. It was a bad practice economically in the beginning. All the fertility which Nature had stored up for thousands of years, was at the disposal of the extensive farmer. Usually he has succeeded, in from twenty-five to fifty years, in exhausting all this accumulated supply. This is instanced by the well known fact of the rapid decrease in fertility of the virgin soils of the country. Whether they originally were wooded or prairie, the same result is seen. Some of the deeper and more fertile soils last longer, but the shallow and rolling soils rapidly succumb. It is far better, therefore, while still being proud of the birth on a farm, to forget all else except that one fact in resuming agricultural activities.

"Book farming is deceptive and misleading, and the book farmer is doomed to failure." The above statement is both true and false. Book farming is apt to exaggerate the good points and minimize the difficulties of scientific agriculture. This is especially true of official bulletins, both national and State. The law should require that all failures should be as carefully recorded as successes. A book on farming which would feature the failures as prominently as it did the successes would not be a misleading book.

It must not be forgotten that the chances of the old time farmer resuming his place on the farm are decidedly bad. The doctrine of probabilities does not work out in his favor. He is more likely to fail than to succeed. He is, however, certain to fail if he relies upon the old methods. His only hope is in the reasonable application of the facts which the science of farming has developed. These fundamental facts were never taught to the boy upon the farm of a quarter of a century or a half century ago. What is the fundamental fact of successful agriculture? It is this: the soil is not dead, inert matter; it is a living organism, it demands care and protection, above all it asks for food, it has its idiosyncrasies. The successful farmer is necessarily a psychologist. He studies the mind of the soil. No one can sit down and describe just what a field is like. The fields are fitful as the maidens. They may never be in the same mood two years following. They will fancy this or that, as the passion may seize them, but one thing they never forget and that is to eat. It may be kainite to-day, it is likely to be fish scrap to-morrow, but the field "wants what it wants when it wants it."

Science shows the way. The farmer, however, cannot be made by science alone. He must have the sense of the real farmer. As Whitcomb Riley puts it, he must be able to divine the "feel in the air."

From another point of view the early experience on the farm is likely to be a handicap. As a rule it is not always agreeable. The life of the old-fashioned farmer's boy is a hard one. The man will perhaps retain the feeling of the boy, that labor is a curse, especially farm labor. Above all things the intending farmer of mature years must forget that labor ever was a curse. He must feel that it is an opportunity and a joy and a blessing. His early experience on the farm is not likely to help him along in that line. Of course he begins his new labors from a new point of view. His attitude towards the plow is quite different from that of a boy; but it is hard to get over these early impressions, and hence the intending farmer is more than likely to look forward to a career of resting in the shade and watching other people work. Rest of course is not only physiological and necessary, and delightful, but there can be no rest if there is no work, and the modern farmer should not sit in the shade until he has earned that right by becoming fatigued in the sun.

But approached from the point of view of science, the labor of the farm is a continued joy. It is a manipulation of the laboratory which the real chemist does not relegate to a helper, it is the touching of a canvas by an artist's brush which cannot be left to an amateur. The hired man can never put a soul into a field any more than the hired painter can put a soul into a picture.

For these reasons the man who was born in the city, and who by the great impress of heredity some time in his life feels the lure of the land, has a good chance to become a good farmer, perhaps as good as the boy who was born upon the farm. I do not claim for a moment that every man, even if born in the city, could be successful on the farm. That is not reasonable. A lot of people who were born in the city can never become farmers, any more than boys born on the farm can be. We must not forget the natural tact and ability, without which none of us can ever succeed in anything, no matter how patiently we try.

The point which I wish to accentuate is that when

THE HIRED MAN CAN NEVER PUT A SOUL INTO A FIELD

RESTING IN THE SHADE AND WATCHING OTHER PEOPLE WORK one goes at a plump age to till the soil, he must carry with him the knowledge which science has taught and the implements which the artizan has devised. The old methods of farming to which he was accustomed when a boy are as obsolete as the old implements of agriculture. I remember well when the first machine for cutting hay came into the community where I lived, and a few years after when the first machine for reaping wheat was introduced. I have seen myself and my father and his helpers go into the field with cradles. I remember his telling me what a wonderful thing the cradle was as compared with the sickle of his boyhood days. "The cradle," he says, "has revolutionized the wheat industry and made it possible." So did the sickle in its time. And yet, what would you think of the farmer of to-day who, in starting out in his new career, would buy a cradle for his wheat cutting instead of a reaper and binder, or engine and thrasher, or would cut clover with a scythe instead of a mower? Improved machinery has made extensive farming economical, but it is just as easy to harvest a field of wheat that yields thirty bushels per acre with the reaper and binder as it is to harvest one that yields thirteen, and the economy of the larger yield is readily appreciated.

It is a good heritage to have been born upon a farm, but the farming of our boyhood days is a thing of the past in so far as economy and fruitful farming are concerned. This is the day of the food specialist. It is not always the cheapest food that is the most economical. The idea that a field can be fed solely from its own resources is preposterous. At least a part of the crop must be taken off every year, and the resources of the field are diminished to that extent.

To-day the farmer who farms without the economy of manure, without a knowledge of any deficiency in plant food that his field has, without the knowledge that the leguminous crops can increase the store of nitrogen, without the knowledge that certain crops, such as the leguminous, will not grow in an acid soil, without the knowledge of the kind and quantity of so-called commercial fertilizers he can buy, is a man who starts out on his career with a certainty of defeat staring him in the face.

To succeed to-day on the farm requires courage, industry, tact, knowledge, patience, enthusiasm and brains. As S. E. Kiser says in his poem "Where Brains Are Needed":

"I claim it takes more brains to farm," said Ebenezer Brown,
"Than what it does to git ahead and make a splash in town;
Why, I know six or seven chaps from this here neighborhood
Who went away to cities, where they 're busy makin' good.

"You take Chicago and New York — size up the big men there —
The lawyer, doctor, merchant and the multimillionaire —
You 'll find they 've all been farmer boys, or lived in towns, at least,
Where they could have a chance to learn the ways of bird and beast.

"Now take these city chaps who come to cultivate the land —
I don't mean millionaires who farm for fun, you understand —
But take the common city folks who try to farm, and say!
It 's pitiful the way they try to make their farmin' pay.

"I 've saw a dozen of 'em fail; I never seen one yet
Who managed to be prominent or not get into debt;
And so I claim a man may make an awful splash in town
And not have brains enough to farm," said Ebenezer Brown.

V

THE DAIRY THE HOPE OF THE SMALL FARMER

THE farmer who does not keep a cow has failed to appreciate one of the fundamentals of agricultural life. Not only is he to keep a cow, but she is to be a healthy cow. She is to give the milk and butter for the family, and especially for the child. If she be afflicted with tuberculosis or lumpy jaw or any infectious or repulsive disease, she is a great threat not only to the grown members of the family, but especially to the children. The skilled veterinarian as a rule is not out of reach, and the examination of the farmer's cow for disease should be as thorough and as patiently performed as if the farmer himself were applying for a life insurance policy. Indeed, that is what he is doing when he calls in the veterinarian to tell him whether or not the farm cow is diseased.

The cow should be a good one, not necessarily registered, but at least a grade of some established milk and butter producing breed. The Jersey, the Guernsey, the Alderney, the Holstein, the Swiss, and other breeds, are notable for their large yield of dairy products. The Jersey and the Guernsey, especially, are noted for the high content of butter-fat which is found in their milk. The Holstein produces a larger quantity of milk, but with a less percentage, though an equal quantity, of butter-fat.

The farm cow should be well groomed. She should not be permitted to become infected with her own filth, as is too often the case. She is to be kept clean and well curried, and especially is she to be well fed if a maximum production of milk is to be obtained. The small farm indeed must have two cows, calving at different periods, so that there is always milk and butter to be had upon the farm. In fact, for the small farmer who lives near a large city there is probably no safer investment than to keep a few cows for milk-marketing purposes.

ECONOMICAL FEEDING.

Even with the small farm the cows can be kept in clean, dry lots and barns, and fed during the summer months with the green products of the field. It is estimated that one cow kept in a stall can be maintained with one-third of the land which it would require if she were turned out to pasture. Hence the farmer with no more than seventy-five or one hundred acres may keep from fifteen to twenty cows, and keep them well. He can do this by growing the crops which he feeds them instead of turning them out to pasture. Unless cows that are kept up are properly stabled and have pure water and pure air, as well as good food, they are much more subject to disease than when they run at large in the pasture. Therefore the small farmer with a small herd must give extra care and attention to the health of his cattle. He cannot afford to let them go more than a year at a time without a careful inspection by a competent veterinarian to determine whether any of them is afflicted with incipient tuberculosis or other contagious disease. It would be fatal to a herd that is kept in the stable to have a single individual thus afflicted. Only by vigilance of this kind can the herd be kept in a state of health suitable for the production of potable milk.

It is a crime of the worst character to sell milk from an infected animal. It may go into a home where an infant or young child is nourished by it, and the most dreadful of all diseases, tuberculosis, may be conveyed in this way from the cow to the human being. I am aware that this theory is contested by authorities eminent and worthy of consideration. Especially did the great Dr. Robert Koch combat the theory that bovine tuberculosis is communicable to the human animal. The weight of authority, however, supports the theory of the possibility of communication. In such circumstances the only safeguard is to give the benefit of the doubt to the consumer.

AN OBJECT LESSON.

I have a near neighbor, a college graduate, who has a small farm of one hundred acres and a small herd of a little over a dozen cows. He is able to make a very decent income from the proper scientific handling of these animals. If he had to depend upon a pasture alone to give them their green food in summer, it would be difficult to sustain them in a proper condition for the production of the maximum quantity of milk on a farm of this area. In the soiling process the green crops are harvested and fed to the cattle, and thus from a small area a large quantity of fodder can be produced. One of the earliest of the soiling crops is rye, and this is followed by alfalfa, clover, and then later by cowpeas, vetch and Indian corn, so that from early spring until late autumn a continuous succession of green crops is available. Good feeding is the first step in getting good milk.

THE SILO.

The food of the dairy cow may partly be derived from ensilage. There is much to be said in favor of ensilage and but little against it. Judged by the cow's taste, it is almost an ideal food. She eats it with avidity. Indian corn is the common material of which ensilage is made in this country. Green rye, cowpeas, green clover and alfalfa and other so-called soiling crops are occasionally used. The best period for harvesting ensilage corn is at the time the grain has just become hard and the stalks and blades have not lost their succulence. The cutter should be so adjusted as to cut the material into pieces of small size. From a quarter to half an inch in length makes an ideal ensilage. Longer pieces even up to an inch may keep very well. As the material is put into the silo, it must be well distributed, evenly over the surface, and tramped as close as possible. The heaviest man on the place should go into the silo during the filling. If the corn is over ripe the keeping qualities are improved by sprinkling water over the shredded mass. The fundamental condition which is to be obtained within the silo is that it should be air tight. Wherever there is a leak, the silage will be spoiled. From a foot to eighteen inches of the top of the silage is unfit for food. The silo is usually built of wood staves. Hollow tiling and concrete structures are now coming into vogue.

Two objections are made to the use of silage as food for milk cows: The silage is said at times to give a bad taste to the milk. In such cases the silage is either of poor quality, or fed in too large quantities. The acidity of silage is said to soften the teeth and thus limit the period of the cow's usefulness. This also is not likely to happen when the silage is of good quality. Silage is not a complete food in itself. When made from Indian corn its nitrogen content is low. It should, therefore, be fed in connection with a rich nitrogenous food, such as bran, oil cake, clover or alfalfa. When the ration is properly adjusted silage is the most economical bulk food that can be had. The provident farmer will not fail to fill his silo during the last days of August or first half of September, even if he has not put on the roof nor torn away the scaffolding used in its erection. The silo is a graceful structure and when artistically roofed and properly painted adds an element of architectural beauty to the plain sheds of the dairy buildings.

The dairy is a better bet for the beginning farmer than the orchard. Its income is more prompt, and while it may not be so great in spots, it is evenly distributed over the year. With a clean product from healthy, well-kept animals, a good farmer near a good market ought to be able to realize twenty cents a day net on each animal he keeps. I mean that this is the profit after paying for freight charges, maintenance and service. A net income of three dollars a day in cash, together with what the farmer can get off of his fields for his own table, is quite an item in the prosperity and comfort of a modest farm life.

Unlike the orchard, the dairy is not likely to be overdone. Unlike the orchard also, the dairy is profitable in proportion as it is near a profitable market. Fruit can be more safely transported over long distances than milk. To the near market fresh milk and cream can be sold. For the distant market butter and cheese are the merchantable products. The same note of warning, however, must be sounded in respect to the dairy that has been voiced in regard to the vicissitudes of orcharding. Success is by no means assured, except when rigid principles of economy and efficiency are adopted and followed. Personal attention, personal labor and personal pride and pleasure, are important factors in the problem. The man who does not love the cow has no business with a dairy, any more than a man who does not love a tree has with an orchard.

THE CRADLE HAS REVOLUTIONIZED THE WHEAT INDUSTRY

WHAT WOULD YOU THINK OF THE FARMER TO-DAY WHO WOULD BUY A CRADLE FOR HIS WHEAT CUTTING?

VI

THE FARMER'S WIFE *VERSUS* THE DAIRY COW

THREE years ago I was invited to address the State Dairymen's Association of Vermont, at Burlington. I had had opportunities of seeing some of the Vermont farmers' houses and also the Vermont dairy barns. I had been struck with the fact that more attention, in some cases, was paid to the comfort and convenience of the dairy cows than to the comfort and convenience of the farmer's wife and daughter. It was a large, intelligent and fine-looking audience that I faced on that cold day of January, with the thermometer many degrees below zero. I thought this was an opportunity to say a word in favor of the farmer's wife, and I began my address with the following question: "Why is it that so many Vermont dairymen pay more attention to their cows than they do to their wives?" No one answered the question, and yet many of them could have done so. Soon thereafter I received a letter from the wife of a Vermont dairyman thanking me for getting at the crux of the dairy question.

Being in the dairy business myself in a small way, I fully appreciate the necessity of care for the cow. I have spent a good deal of money in getting concrete floors and steel stanchions, where cows can be kept in a cleanly and sanitary manner. I take pride in seeing my cows clean, well fed, and protected from the inclemency of the weather. I have no word, therefore, to say in opposition to the proper care of the cow. As is so often the case, however, in business, the quest of the almighty dollar blinds one to the amenities of life. The farmer's wife and daughter should also be cared for. When I purchased the old colonial stone house in Loudoun County, Virginia, I found neither in the house nor on the farm any sanitary convenience for man or beast. I thought my first duty was to my family, and before beginning my dairy barn, I installed a complete hot and cold water service in the old residence. A small bedroom was converted into a bathroom and closet and hot and cold water were made to circulate through the old rooms before the foundations of the dairy barn were laid. In so far as I know, at that time there was not a farmer's house in my immediate vicinity which was provided with modern, ordinary, sanitary appliances. The object lesson, however, was not lost, and many of my neighbors have not only built silos since I built the first one in the neighborhood, but also have put modern sanitary conveniences in their houses.

EVERY DAY AND ALL DAY.

The farmer's wife is not supposed to occupy an enviable position. Her working day is quite as long as that of her husband, and the husband has one advantage, namely, that one day in seven he rests. Not so with his devoted spouse! The rest-day is often her busiest one, for neighbors may come in to visit and to dine. Thus her duties extend over 365 days, or 8,760 hours, or 525,600 minutes, or 31,536,000 seconds yearly. The farmer's wife, therefore, is entitled to consideration. She is poorly paid for her services, for her husband usually handles what little money comes into the family coffers. Too often it is doled out to his wife in driblets wholly insufficient for her needs. She sometimes is denied the spring bonnet and the spring gown, so dear to every woman's heart. If her husband asks her to go to church on Sunday she declines because of having nothing to wear. She very often carries the water from the spring. I have repeatedly seen her chopping her own stove wood. She does the milking and churning. She gathers the eggs and cares for the chickens. She does practically all the work that is done in the garden. If there be any flowers in the yard, she plants them. If the grass be ever cut in the yard, she cuts it. A ministering angel, without vacation and without surcease of effort, she is the typical martyr! Any amenity that can be introduced into the life of the farmer's wife is worthy of the consideration of every person who has a real interest in agriculture.

ISOLATION AND INSANITY.

I need not go into the further question, which has often been mooted, as to the increasing percentage of insanity among farmers' wives. I have not access to statistics on this most interesting theme. I can only say this, that if a larger percentage of farmers' wives are not insane, it is a matter of wonder. The life of isolation which they lead, the continual round of monotonous duties in which they are engaged, the lack of sympathy and attention so often manifested on the part of farmer husbands, are all factors which would tend to derange a delicately poised mentality.

In addition to this, the old-fashioned farmer's wife,—and there are thousands and hundreds of thousands of them living to-day,—has never had the benefit of the advantages of oral hygiene. She has rarely been permitted to consult a competent dentist. Among other misfortunes which she has to bear, is an early toothlessness. The agony which she suffers, the pain which she endures, the discomfort which she encounters in the early decay of her teeth, and the lack of surgical attention at a proper time to save them or to remove them, are parts of the hard environment which surrounds her.

In most of the laws regulating labor the farmer and his family are not included. I would be an earnest advocate of a law limiting the hours of labor of the farmer's wife. I would like to see a system of instruction, beginning in the agricultural schools and colleges and gradually spreading to the farm, which would lead the farmer to be more considerate of his wife. By providing her with the proper conveniences for doing her work, namely, a commodious, well-ventilated kitchen, with running water, a proper sink in which her dishes can be washed, a laundry equipped for easy service, and other conveniences to mitigate the severity of labor, which the farmer could easily procure and should procure first of all, he would lessen her hours of application so that from four to six hours a day she could have at her own disposal. Likewise in the spring-house, the proper conveniences for keeping the milk, for churning, for the easy application of sanitary measures, would not only make a better product for the table, but would also lessen the severity of the labor.

ONE DAY OF REST.

Sunday, especially, should be made a holiday, and cold meats should be part of the sabbatical observance.

The church should not be beyond her reach. A clean buggy from which the dirt and mud are carefully kept, a nice horse with well preserved harness, and a becoming bonnet and gown, should be at her disposal to attend the church and see the beauties of country life. The first duty of the farmer should be to his wife and family, in the way of making them comfortable.

If a system of farm credits can be devised, among other things which should be regarded as a legal expenditure in the borrowing of money, should be the comfort and convenience of the house. We are told that the chief danger to be guarded against in rural credits is to see that the money which is raised by the pledging of the farm property be applied for farm purposes. What more worthy purpose on the farm could be imagined than making the home comfortable! One need not wonder that the mother, engaged in the duties which I have described above, favors in every possible way for her son a life as far removed from that which she lives as possible. In the future of her daughter what greater concern could she have than to see to it that her own life be not duplicated in that of her child! Thus one of the great incentives for the leaving of the farm would be removed if the home could be comfortable and the labor of the housewife lessened.

While I favor all the large measures which look to the improvement of the condition of woman and her participation in public affairs, while I am an advocate, and have been for a third of a century, of equal rights before the law for man and wife in every respect, I feel that even a greater service to humanity could be secured if industrial freedom and equality, as well as political freedom and equality, could be secured for the woman in the farmer's home.

VII

THE ORCHARD A RECREATION AND SOMETIMES A SOURCE OF PROFIT

EVERY farmer worthy of the name would have about him enough fruit trees to supply at least the needs of his family for the year. It is well known that there are many localities where the character of the soil and the contour of the surface are peculiarly favorable to orchard products. On the other hand, there is hardly a farm in the United States which will not produce some kind of orchard fruit in sufficient abundance for family use. There are vicissitudes of the weather which are obnoxious to all orchards, even in the most favored localities, but a fruit tree which is properly cultivated and properly nourished will have a power of resistance which is quite phenomenal. In this respect the tree and the human body are quite alike. The well nourished body is very resistant to disease. The well nourished tree is peculiarly resistant to the vicissitudes of the environment to which it is exposed.

One broad principle should be laid down as the basis of tree culture, namely, the tree should be nourished in such a manner as to promote its vigorous growth in the early part of the season. Plant food and cultivation should be so adjusted as to secure a complete hardening of the new vegetation before the frosts of autumn set in. It is a mistake to manure a fruit tree and cultivate it and water it in such a manner as to have it still green and growing when winter approaches.

COMMON NEGLECT OF THE HOME ORCHARD.

I am well within the bounds of truth, perhaps, when I say that the manuring of an orchard tree is an unusual activity of an ordinary farmer. Too often the orchard is planted on a hillside unsuited for cultivation, and the trees are allowed to grow *au naturelle* from the time of planting until their final decay. I have been through orchard after orchard on many farms where the trees are kept only for home use, in which I found neither cultivation, fertilization, pruning nor spraying. The tree is left absolutely to grow wild and abandoned to its own whims. Such fruit trees as these are unprofitable. They usually simply take up space and yield no crop. In many cases, however, these trees yield moderate crops. I gathered from one of them an apple fifteen inches in circumference and weighing one pound and a half.

If, however, the tree is of good variety, it is not advisable to cut it down, even if it be many years of age. The sharp pruning hook in a skilled hand in a few years will change this savage tree into a civilized product. It will look as different as a man whose hair and beard have not been cut for years who submits himself to the skill of the tonsorial artist. Proper cultivation and the application of food will do the rest, and out of the abandoned old orchard a new and vigorous orchard is easily produced.

CULTIVATION OF THE LOVE OF THE BEAUTIFUL.

There is another most excellent reason why the small farmer should have a few trees of his own. To care for a tree is in itself a higher education. It appeals not only to the intellectual faculties and to the skill of the forester, but it makes a still higher appeal, namely, to his esthetic faculties. There is nothing more beautiful than the bloom of the fruit tree, unless it be its ripened fruit. A well kept fruit tree near the house will be a strong factor in the ethical and esthetical education of the child. Whitcomb Riley's experience in the apple orchard might be easily that of every farmer, farmer's wife and farmer's child. It is not alone the poet who can be "knee-deep in June."

> Orchard 's where I 'd ruther be —
> Need n't fence it in fer me! —
>   Jes the whole sky overhead,
> And the whole airth underneath —
> Sorto' so 's a man kin breathe
>   Like he ort, and kindo' has
> Elbow room to keerlessly
>   Sprawl out len'thways on the grass
>   Where the shadder 's thick and soft
>   As the kivvers on the bed
>   Mother fixes in the loft
>   Allus, when they 's company!

I do not know of any labor on the farm which is possible of being made more productive of the cultivation of the finer feelings of the laborer than that which is devoted to the care of a tree, and especially a fruit tree.

THE ORCHARD A HELP TO HEALTH.

There is still another valuable point of view in favor of the maintenance of a small farm orchard, namely, its relations to health. Although raw fruits are unsuitable for the early ages of life, they become very valuable for children over five years of age and from that on to the end of life. The judicious admixture of fruits with the daily diet cannot fail to have, in practically

CUT CLOVER WITH A SCYTHE INSTEAD OF A MOWER

MULE HARVESTER AND THRASHER

all cases, a beneficial effect upon health, while at the same time it administers to a praiseworthy taste. The various physiological and nutritional aspects of fruit are hardly to be discussed at the present time. As an article of diet alone fruits are unbalanced, that is, they do not afford all the elements of nutrition in the proper proportion. They are particularly deficient in the elements which restore the waste and build the new tissues of the muscles and other nitrogenous portions of the body. They are rich in carbohydrates and organic acids, important food products having most intimate relations to health. The acid of the apple and other fruits of that kind is malic. The acid of the orange and other citrus fruits is citric; while the acid of grapes is tartaric. All of these acids in their natural habitat are capable of being burned in the body and yielding energy, and finally producing carbon dioxid, which, uniting with the bases of the foods, produces the carbonates and bicarbonates so essential to the proper maintenance of the alkalinity of the small intestine and of the blood. Fruits, therefore, become a powerful safeguard against the evils of acid intoxication. Thus it becomes the duty of the farmer, in his relations to the health of his family, to supply a sufficient amount of fruit for the necessities and needs of the year.

It is far better, also, that he produce them himself and thus get the benefit which the care of the orchard confers, rather than to spend his hard earned money in buying fruits of his neighbor. The orchard on the farm, even if not a single bushel of fruit is sold, becomes a source of profit in the supplying of a highly wholesome and in many respects indispensable diet.

I have already told of the dangers which attend the efforts of the unskilled to engage in fruit grow-is well set forth by Mr. C. J. Tyson, President of the State Horticultural Association of Pennsylvania. He says:

(*The Apple World,* June, 1914.)

Hardly a week goes by but we read or hear of some one who tells us that too many apple trees are being planted, and that very soon apples will sell only at a loss, and the whole business will go to the dogs.

Of course, we put up a good bluff and call these folks "calamity howlers" and "pessimists," but down in our hearts we know there is a lot of truth in what they say. Trees by the million have been and are being planted. Hundreds of thousands are coming to bearing age each year, and this number will increase tremendously in the next five years.

Each season for several years past nature has so planned that calamity of some kind, either frost, severe storm or drouth, has visited several of the important apple growing sections, and the crop has been cut down. This condition may not continue; even the coming season may see a "bumper crop" throughout the whole country, then "what will become of the apples?"

It sounds bad, but it is not hopeless. Here is the solution. Only a very small part of the population of our country is eating apples. There are actually millions in our cities and towns who do not have the "apple habit"; who do not know about apples. It is our duty, and should be our business, to let them know. Some experiments in advertising have already proven that a little publicity can greatly increase apple consumption. Proper advertising will increase the consumption of anything, and if the article has merit and the advertising is judicious, it will pay, and pay handsomely.

VIII

HEALTH ON THE FARM

THE farmer should live longer than the urbanite. Does he? The answer appears to be negative in the case of some diseases. The farmer lives in the open at least by day, should have access to fresh and wholesome food and as a rule is not worried by cares of business. Therefore, he should live longer than his city cousin.

On the other hand, the farmer sleeps in poorly ventilated rooms, especially in winter, his food is often largely composed of products he cannot sell. The choice bits of the farm's products go to the city. The farmer too often keeps for himself the specked apples and small or injured potatoes. He is exposed to violent extremes of heat and cold. He shivers with cold and is half baked before his open fireplace half a dozen times a day. In hot weather he works at planting or in the harvest field twelve to fourteen hours a day. He eats hurriedly and does not as a rule get sufficient rest. He is peculiarly prone to have typhoid fever, pneumonia and influenza. The cooking in his home is too often of the greasy kind. He has "hot biscuits" once and often three times a day. His meats in winter are usually home cured, and, therefore, subject to all the disasters that follow unskilled handling. I think I may say without transgressing the truth, that the farmer has far poorer sanitary surroundings than the city man. The farm springs or wells are likely to be polluted with the excrement of man and beast. The milk which forms so large a part of the food of the young rarely comes from a tuberculin tested cow. There is no competent inspection of the meat-food animals slaughtered for home use. In fact the farmers of this country have put too much thought on the barn, the pig pen and the dairy. They have reserved none of them for such puerile problems as home and barn sanitation. No wonder then that so few centenarians are found among our rural people. At best the average length of human life in the United States is only forty-four years and the members of the farmers' families are not doing much to make it longer.

DISEASES THAT THRIVE IN THE COUNTRY.

There are certain diseases which seem to be peculiarly attracted to rural districts.

Statistics as to the causes of the excessive mortality in the country are not sufficiently reliable to draw any general conclusions. There are some diseases on the other hand which appear to be more frequent in the city than in the country, but the extent of complete registration is not sufficiently general to warrant any definite conclusions except from the states of California, Colorado, Connecticut, Indiana, Kentucky, Maryland, Massachusetts, Michigan, Minnesota and Missouri. For instance, organic diseases of the heart are more common in some states in the city than in the country. This is true of California and Colorado, while in Connecticut organic diseases of the heart are more common in rural districts. In Indiana they are about the same. In Kentucky the organic disease of the heart is more common in the city, both among the white and the colored population. In Maryland the same ratio prevails both among the white and colored population. In Massachusetts, however, organic diseases of the heart are more common in the rural population. The same is true in Michigan and Minnesota, while in Missouri the opposite condition obtains. Thus from a general survey it may be said that there is not much difference in the frequency of death from organic diseases of the heart per 100,000 people in the country or in the city.

While the data are not at all complete and to a certain extent not conclusive, it seems almost certain that among the diseases mentioned below mortality is greater in the country than in the city. It will be of interest in the future to have a more careful study of this point. In order that some of these comparative data may be more easily illustrated they are presented below in tabular form.

DEATH RATES PER 100,000 POPULATION IN CITIES AND RURAL DISTRICTS

Disease	State	Rural	City
Typhoid	Colorado	37.0	19.1
"	Maryland	43.7	30.6
"	Kentucky	49.0	34.0
Influenza	Minnesota	10.4	4.3
"	Michigan	24.8	7.7
"	Connecticut	31.4	19.8
"	Indiana	21.2	12.0
"	Maine	28.7	13.6
Apoplexy	Connecticut	131.2	90.8
Mental alienation	California	5.1	1.5
"	Colorado	4.0	2.3
Cancer—Skin	Connecticut	4.1	2.1

These facts must be kept in mind when we speak, as we generally do, of the country life as being conducive to health and longevity. Evidently this is not always the case at the present time. On the other hand, it is, I think, capable of demonstration that when a perfect sanitation of the country is secured, as will necessarily be the case in the near future, and when proper attention is given to the sanitation and ventilation of farmers' houses, the death rate from these diseases will certainly be less than it is among the urban population.

It is worth while to trace the causes which shorten the farmer's life in greater detail.

One of the important threats to the health of the farmer is his exposure to extremes of weather. When the temperature is far below zero he must go about his work. The stock must be fed and watered, the fuel brought in and errands must be run to the town. If he be in the dairy business he must rise hours before the dawn and drive many miles through snow and wind to the depot. In like manner he is exposed to rain and storm. While hot from working in the field a sudden shower accompanied by hail may chill him to the bone. Drenched with rain, far from home, it may be hours before he can change his clothes. During seeding and harvest his day's work extends to fourteen hours and his short sleep does not give nature a chance to restore his wasted tissue and remove fatigue. His bathing facilities are either nil or restricted to a wash bowl or tub. The old-fashioned farmer's life,— and the new fashion in too many instances is no better,— affords abundant opportunities to weaken vitality and strike at the citadel of health. Those diseases which overexertion and undue exposure help along, such as rheumatism and pneumonia, are very common among the hard-working farmers and their wives. Overstrain, long hours of

Photo by Harris & Ewing

UNLESS COWS ARE PROPERLY STABLED AND HAVE PURE WATER AND PURE AIR THEY ARE SUBJECT TO DISEASE

Cow stable on Dr. Wiley's farm

labor, and exposure to the vicissitudes of weather favor also the lodgment of the germ of tuberculosis in the lungs or other parts of the body and encourage its speedy and vigorous growth. The poorly ventilated sleeping-rooms of the winter add a contribution to the breaking down of the farmer's health. The cooking in many farm houses is far from the best and this adds to the tendency to acquire disease. The soggy bread, made quickly from baking powder, in which the starch has been only lightly changed, helps to increase dyspepsia and its attendant evils. Denied the privileges of the bathroom and toilet, he does not give proper attention to the insistent needs of promptly disposing of the wastes of the body.

The general disregard of the requirements of good sanitation often leads to an infected water supply. The spring is contaminated with the offal of pigs and chickens. The well is polluted with surface drainage and the cistern is foul with the debris of the roof. These are the shadows which rest upon the neglected farm house, the cabin of the tenant and the shack of the laborer. In the city the health officer looks after the water and food supply, certifies the milk and sees that the garbage and ash man attend to the back yard. The man with typhoid and the child with measles are segregated. The dictates of sound sanitation are heeded. The water is freed from typhoid germs by sand filtration. The people are instructed respecting the ventilation of the sleeping rooms. Reasonably effective safeguards protect the citizen from wandering diseases or local epidemics. It is true, of course, that many country homes are properly safeguarded. It is likewise true that many cities are poorly protected. I have pictured only types which are commonly met. No wonder, therefore, that the farmer breaks down long before his time. He is shaggy and gray at forty, shriveled and wrinkled at fifty, stooped and trembling at sixty, he has gone to his eternal rest at seventy.

But there is a bright side to the picture.

The farmer of the future will be the youngest man of his years in the whole community. His step will be resilient, his eyes bright and his joints flexible at an age when he now is old. From the very nature of things the man on the farm in the future should be the healthiest of all human animals. He will have access to pure, fresh, wholesome foods, which may be easily well cooked. His hours of labor will be shortened, yet made more efficient. His life in the open will give vigor, endurance, and power to resist infection. He is not likely to be tempted to indulge in alcoholic liquors. He will learn in the near future that the use of tobacco is wholly unnecessary, filthy, and reprehensible. He lives nearer to nature than any other person and ought to love nature better than any one else. Some day he will have pure, clean water, free from sewage or surface infection, to drink. He will go to bed early and rise at daylight. He will see the sun rise as well as set. His exercise will develop the physical man symmetrically and thus give a healthy dwelling for a healthy mind. Some day he will be wise enough to lose faith in quacks and nostrums, advertised in newspapers and magazines. The "Reuben" of the hoary "gold brick" trick will "get wise" also to these vicious attempts to utilize his gullibility in respect of alleged cures. The itinerant peddlers of nostrums, cocaine and consumption cures will discover a falling market and a better informed customer. It is pathetic to think of the sickness, suffering and death in rural districts that have come from a fatuous reliance on so-called patent medicines. It is true the country doctor is not a specialist, but he is a mentor, a guide and a healer of greater skill than many a city physician. He is trustworthy and effective in all ordinary diseases. He knows also where to send his patient for removal of the appendix or any capital operation involving a vital organ. The farmer is not without the means of good medical service when he needs it, but even in the case of a devoted family he misses the helpful ministration of the trained nurse.

While certain diseases thus show a greater frequency in some of the states in rural communities, upon the whole the death rate from all causes is lower in the country than in the city in all the states reported by the census except in New York.

The children on the farm are better nourished as a rule than city children. They have more "whole foods" from which the tissue building materials have not been all removed. They have whole cereal products which nourish especially the bones and the teeth. They have at least plenty of skim milk containing practically all the tissue building materials of the body. They have fruits and vegetables which have not been denatured in preparing them for the table. They live largely out of doors and go barefoot and plunge daily into the "old swimmin' hole."

The child in the country is at a greater disadvantage than his father, if he falls ill. The country doctor is certainly not a specialist in children's diseases. But a consulting pediatrist may be easily called from the city in emergencies. The country boy at least has good teeth if he be taught the use of the brush. By reason of the lime and phosphorus he has eaten, he is blessed with strong, hard, resistant teeth, which with cleanliness and care may well abide with him during his threescore years and twenty.

The farmer's girl is not so fortunately situated as the farmer's boy. Through false and sometimes fatal modesty on the part of her mother, she grows to puberty utterly ignorant of her real nature. Alas! too often a chronic invalidism is the price of such criminal negligence.

The time is not far distant when every farm will be subjected to rigid sanitary provisions, such as are found in the best of our cities. The police powers of the State, in so far as sanitation is concerned, will be extended beyond the cities and into the rural communities.

The sick-bed of the country home will be guarded by the same precautions for the protection of the well, as are now found in the hospital and the well conducted city residence.

Taking all the favorable and unfavorable points together it may confidently be predicted that the average life of those who live in the country will soon greatly exceed that of any urban population. I urge the farmers of this country to give heed to the problems of sanitation outlined above. Do not buy a motor car until all your houses are clean and well ventilated. Provide a place for your children to have their daily bath. Put hot and cold water with bath and toilet in your home, provide a septic tank to dispose of the wastes of the house so no danger of infection may occur. Your life, that is, your health, is your greatest wealth. Don't scatter it like a spendthrift to the four winds of ignorance, infection, bad food and bad cooking.

IX

FARM LABOR

THE great problem of farm life is not agricultural credits nor rural banks, nor yet free markets and capacious warehouses, but something that goes before and ahead of all these, namely, the work on the farm. It is indeed a small place that the farmer by himself can till.

In spite of the rapid strides of women towards equal rights with men, there is a natural ineptitude in the sex to farm work, which will practically reserve that kind of labor for the male sex. It is true that in the very populous regions of the Old World the women do a large share of the farm work. It may likewise be true, as claimed by many students of evolution, that among primitive peoples the women practically did all the work, while the men did the fighting and the hunting and the loafing. I believe this condition is true yet in many of the aboriginal tribes of this country. Woman, in assuming again her position in the industrial world, will hardly care to press her claims to the extent of becoming the dominant factor in farm labor. While I claim to be a progressive of the most pronounced type, and especially have been for forty years an advocate for equal rights of men and women at the ballot box, I still confess to a slight prejudice in favor of men doing the farm work. I have not been impressed with the conditions of life which I myself have seen in older countries, where women are mingled with men in the fields and hitched with dogs to the carts.

Far be it from me to advocate a condition of affairs in which one sex lives in idleness. There is plenty indeed for women to do, and the idle woman, like the idle man, is a constant threat to society. But the farmer's wife and the farmer's daughter in my opinion cannot be justly expected to join him in the work of the fields. He may have sons who, after the age of ten, would be of some use on holidays and vacations, and after they are eighteen may give him three years of full handed labor. The boy, however, soon becomes a man in his own rights, and the farmer who depends upon the labor of his sons alone, will in due course come to the limit of his tether. Just as the manufacturer cannot do all of the manual work of the factory, so the farmer who possesses from one hundred to one thousand acres can do only a tithe of the work on the farm.

LABOR FUNDAMENTAL.

The question of labor is fundamental. The one striking fault of agricultural education at the present time is its failure to train agricultural laborers. There should be instruction in the country schools and the city schools of a theoretical and practical nature in farm labor. The idea has grown abroad that farm labor is unskilled labor, and unfortunately to a large extent this is true. Going into my corn field one day, I noticed that the cultivators did not seem to be doing a good piece of work. Upon examination I found that none of the shares were scouring. The rust which had come upon the plate during a period of rest was still there, and instead of the plowshare turning the dirt and showing a sheen of silver, it was simply pushing its way through the soil, failing either to cover the weeds by throwing the dirt, or to cut them by the keenness of its blade. There were three two-horse cultivators operating in the field, and all were in a similar condition. Apparently these unskilled laborers had never been taught the fact that good plowing is only possible when the plow scours. Their idea was to get over the ground, and not to cultivate the corn. With the aid of a jackknife, in a short time I had all the plowshares bright and all of the plows doing excellent work.

Not one of these men following the plows had ever had a single word of instruction in regard to the character of farm labor. They knew nothing except the length of the day and the magnitude of the stipend. To them plowing was not tilling, but putting in the time. They were not indolent, they worked long enough hours, but their work was wholly inefficient. This is not an extreme type. Many complain of the indolence and laziness of farm laborers. My complaint is their lack of knowledge and lack of spirit. This fact, I think, is fundamental. The laborer who is doing a good job takes a pride in his work. If he has a good instrument which is working well, his task is not wholly a burden. He sees in it the soul of the artist, and takes a pride in perfecting it.

These same laborers of whom I spoke a while ago, were taking no care at all in turning at the end of the row. They allowed the horses to begin their turning many feet before the end of the row was reached. They were plowing up and tramping down many of the young plants, so that the end of the field looked ragged and disorderly. I called their attention to the necessity of driving straight out to the end of the row. There was ample room to turn after that. By lifting the plow a very little they could start back in a proper positiōn for the next row. The result was that in less than two hours, not only was every plow doing good work, but every driver was taking some pride in what he was doing.

The cost of labor to the farmer is largely due to this lack of knowledge and lack of spirit. How great a saving it would be if each laborer had received instructions in the proper method of performing his task, and had been shown the correct attitude to assume in relation to it! I have been surprised to see what a transformation a few lessons in efficiency work. I have seen a laborer with absolutely no interest in his work become enamored with it, proud of it, and eager to show the best that he could do. It is, I think, difficult to find any one so sodden, so devoid of ambition, and so indifferent as not to be amenable to some uplift from proper instruction both as to method and as to purpose.

FARM LABOR SHOULD BE SKILLED.

Farm labor is not unskilled labor by any means. It is skilled labor of the highest type, that is, it should be. In point of fact, however, it is now unskilled labor. Any man who can work is supposed to be good enough to work on a farm. More skill is required for farm labor than in any other industry. The laborer, to be efficient, must always be industrious and alive to the problem which is presented to him, but he must be, to a certain extent, a carpenter, a blacksmith and a mechanic. The machinery of farm implements to-day is a complicated study. Every man who proposes to become a farm laborer should have the rudiments of me-

Photo by Harris & Ewing

THE SILO IS A GRACEFUL STRUCTURE AND ADDS AN ELEMENT OF ARCHITECTURAL BEAUTY TO THE DAIRY BUILDINGS

Silo on Dr. Wiley's farm

Photo by Harris & Ewing

JUDGED BY THE COW'S TASTE, SILAGE IS ALMOST AN IDEAL FOOD

Scene on Dr. Wiley's farm

chanics and the care of implements taught to him. He thus takes a pride in his machinery.

Last autumn when it was time to cut the corn, as I was going to the field I was amazed at discovering three of my cultivators standing in the furrow. These were one-horse cultivators used for the last cultivation, when it was not possible to straddle the row. What had happened? Before the cultivation of the field was finished a rain storm had come on, and afterwards the work was not resumed. The implements were left in the furrow. Of course this was contrary to instructions, and when I inquired about it the head farmer was astonished to think that I made so much objection to this disreputable practice. He said, "It was a custom where I worked always to leave the implements in the field." Yes, that is true. You can see it yet all over this country, agricultural implements left exposed to the vicissitudes of the season simply because the men who use them have never been taught how to care for them. Not only do I require all my agricultural implements to be put under shelter, but further than this, that they shall be cleaned and dusted before they are put away. Moreover, the machines which are necessarily left in the field while the work is going on, such as harvesters, et cetera, are covered with a tarpaulin in an approaching rain or when left over Sunday.

I have been amazed to see how quickly men who have been taught to neglect machinery become interested in caring for it and in taking a real pride therein. I would say, then, that the first great problem in labor is the lack of skill and interest in the laborer. But these are not the only conditions of labor that I find are difficult. I realize, I think, that the farm laborer is underpaid. At the same time I believe that he is paid all he is worth, and even more in his present condition of indifference and ineptitude.

I could better afford to pay a careful and enthusiastic laborer, who would see that his implements were properly adjusted and cared for, $1.50 a day than I could pay one, equally as strong and working equally as long, of the usual type, $.75 a day. When I tell my neighbor farmers that we pay too low hire for labor they are horrified. They say that, as it is, they are constantly driven to the utmost endeavors to raise money to pay for farm labor, and yet the labor needs to be done. The growing of crops ought to be done skilfully and carefully at far less expense than it is done at the present time, indifferently and carelessly.

No laborer is fit for farm work who does not take a lively interest in the work and its character, and when he does that and when he is taught the skill that is necessary, he can earn twice as much as he gets at the present time and the farmer is no worse off in paying him double the price.

REGARD FOR CONTRACT.

Another difficulty which the farmer has is lack of regard of a laborer for his contract. Many laborers on the farm are necessarily employed by the day, as it would not be profitable to keep them over the lax season. There are two or three times during the busy seasons of the farmer's year when he has to have excess labor, and these are the times of planting, of harvesting and of thrashing. As you look into the faces of the extra help you realize the magnitude of this great problem. As these are strenuous days, it is customary and proper to pay higher wages. I have noticed repeatedly, however, that men whom I have employed by the month throw up their jobs when a busy time comes around and some one offers them a little higher price. This is due to a numbing of the moral nature. Not only should a farm laborer be taught skill and enthusiasm, but he should be taught honor and duty.

During the present season, after I began to fill my silo, one of the workers whom I had hired by the month quit in the midst of the work. The alleged reason was that the foreman had failed to pay him for a day's work in June, when he claimed to have been present and the records of the farm showed that he was absent. It was evident that this was only an alleged reason. If he had been dissatisfied with not having received his day's wages for June, he would have protested long before. The fact was, however, that just at that time the farmers were offering from $1.50 to $2 a day for men to help them with their corn harvest, and this was too much of an attraction for the laborer who had hired to me for the rest of the season by the month and had agreed to stay up to the beginning of winter.

You can hardly blame the laboring man who looks at it from his own peculiar point of view. In working by the month he receives a little less than $1 a day; by throwing up his job and going to another he would get nearly $2 a day. He forgets, however, that the extra job lasts at the most two or three weeks, and then probably he is out of a job altogether. His reason did not go as far as this, but only looked at the pay by day.

DUTY OF EMPLOYER.

It is the duty of the employers to provide forms of amusement and forgetfulness for the farm laborers. There should be a place where he could spend an hour by night, if he wants to, in billiards or other innocent games. There should be a playground where he could take a part in sport. There should be a library where he could read the current journals and literature, as well as the permanent records in books. The farmers' clubs should provide a "movie" for each community. In fact, the farm laborer should be treated as a human being, and not as a neglected agricultural implement.

In so far as that is concerned, I must say that the good farmer, as a rule, is far more careful of his mowing machine and his disc plow than he is of the welfare of his farm laborer. The farm laborer lives in insanitary quarters, the bath is a luxury unknown to him. In my part of the county there is no old swimming hole. It is many miles to the Shenandoah or to Goose Creek. He sleeps in beds that are not at all attractive to those accustomed to cleanliness. He eats hastily and often poorly cooked foods, and then he flies to the only source of joy he knows, alcohol.

All of this terrible condition must be changed. It cannot be done in a day nor a week; it can only be done gradually. The boy whose destiny is to labor must be taught its dignity. He must realize that he is a human being and is to be cared for as other human beings. He must be provided with decent quarters and proper amusements, and then his life will not be simply labor and intoxication. No wonder that all those who can get away from farm labor seek to do so. There are left only those without ambition or talent.

A new purpose must be imparted to the laborer, and a new prospect of life and enjoyment spread out before him. It is not so much an increase of wages as it is a revision of environment. We should all endeavor to bring about that day when, looking into the face of the farm laborer, we see health, intelligence, enthusiasm.

I HAVE SEEN HER REPEATEDLY CHOPPING HER OWN STOVE WOOD

SHE DOES THE MILKING AND CHURNING

X

PROHIBITION FOR THE FARMER

IN all the arguments which I have seen favoring prohibition, I have never yet encountered a plea for prohibition because of its value to agriculture. One of the stock arguments against prohibition has been that it will injure the farmer by contracting his markets for rye, barley and maize. My experience has shown me that one of the principal benefits which prohibition offers is protection to the farmer. One of the most pathetic sights which I have personally witnessed is that of the man who works with becoming industry and vigor during the week at hard labor on the farm, for small wages, and on Saturday night invests the larger part of his week's earnings in rotgut whiskey.

My farm in Virginia is in what is known as a dry county. There is not a saloon within the borders of Loudoun County, but in spite of the Webb law there still remain the express company, and for aught I know the parcels post. If one takes the trouble to go to Bluemont, the terminus of the Washington and Old Dominion electric railway, at the time of the arrival of the last train on Saturday evening, he will find a large assembly awaiting its coming. This assembly is composed largely of agricultural laborers who have finished their week's task and are now preparing to enjoy themselves. When the express car comes in there is a lively commotion. I don't know how many packages, for I have never had an opportunity to count them, neatly put up in stiff cardboard, are disembarked and eagerly claimed by the waiting consignees. The maximum content of these packages is usually a gallon, though smaller packages are sent to those who have less thirst, smaller means, or better control of appetite.

ADULTERATED WHISKEY.

One of the worst features about this consignment of intoxicating liquors is that it is exclusively, as far as I have been able to observe, what is known as rectified goods. The man at hard labor evidently wants nothing but alcohol, and why should he pay four and five dollars a gallon for it in the form of old, mellow whiskey, when he can get a larger amount of intoxication out of the cheaper, fabricated, artificially flavored substitutes? From one to three or four dollars, according to the number and size of the packages, is paid out by the laboring man, while perhaps his wife and children are living in squalor and want. A few years ago one of these besotted victims, carrying his rifle, passed by the cottage of a friend near my place, on the road to call on an acquaintance near by. Soon thereafter there was a sound of a shot, and the head of the house on whom the drunken man had called lay dead in his yard. This is only a type of the crimes which are committed by those crazed with alcohol, who in their sober moments would be law-abiding and life-respecting citizens.

It is well known that intoxication has two opposite effects upon its victims: One it makes merry, jovial and companionable; another it makes sullen, morose and dangerous. Possibly the character of the drink also has something to do with the effect, and it does seem that those who are able and have the taste to use only old and ripened intoxicating liquors are less vicious and less dangerous under their influence than those who patronize the artificial varieties.

CONTINUING EFFECT OF THE JAG.

The effect upon the farm laborer of his Sunday jag is most disastrous. All day Saturday he is uneasy and inefficient in his work, as he thinks of the approaching hour when his raging thirst, so-called, will be quenched. This is a most unfortunate figure of speech. There is no quenching of a thirst; there is the igniting of a powder magazine. If thirst really existed, a cup of cold mountain water from the near by spring would soon satisfy it. No, it is a craving of the caged lion for liberty, of the starving man for food, of the criminal for blood. It can be satisfied only by the stimulus which brings surcease of sorrow, freedom from the knowledge of fatigue, and a happy recklessness which makes the world for a time look rosy and attractive. Then the Sunday of drinking and carousing, ending in drunkenness and debauchery, then a Monday of sobering and recuperation, during which no work can be done, then a Tuesday of lassitude and depression, due to the reaction from the stimulus, and so we come to the middle of the week before the farm laborer is himself again, only to work for a few days to get means to repeat the debauchery from which he has just recovered.

To this large class of people, brought up at hard labor, often without education, or rather, often without the ambition for education, these dull, long-suffering, stupid wrecks of humanity, the weekly debauch brings the only ray of hope and joy in their lives. Yet if it were impossible for them to secure the means wherewith this craving could be satisfied, this beastly rapacity sated, it would not be long before the normal state of existence would be restored. The craving for alcoholic drinks of this kind is a habit, which, like every other habit, may be broken, although it may seem that life itself is hanging in the balance when an attempt is made to overcome one so strong.

PROHIBITION TO BE EFFECTIVE MUST BE NATION WIDE.

In order, however, to secure immunity from this curse, prohibition must be wider than the county or the state. It must be nation wide, it must be world wide. I have been long coming to this opinion. In my earlier days I consoled myself with the thought that I was not my brother's keeper. Further, I thought that when a man had reached man's estate it was none of my business what he ate or drank, what kind of clothes he wore, what church he belonged to, what party yoke he wore, or what business he engaged in. Not being a teetotaler, I naturally resented any action which would dictate to me what I should serve at a dinner given my friends, or what I should eat or drink at a dinner given me by my friends. Never having been a user of intoxicating liquors of any kind between meals, I thought that the table, like a man's house, was his castle. I did not forget, however, the attitude of St. Paul in regard to the eating of meat, when he said: "If meat make my brother to offend I will eat no flesh while the world standeth." And so slowly I have been driven, like Mead at Gettysburg, to Cemetery Hill, where I have taken my stand against the enemy.

To me it seems only a small sacrifice to make to give up my wines at dinners for the sake of the benefit which will come to mankind. How glad I would be to-day if I could look out upon the broad horizon and feel that nowhere beneath the sun on this revolving planet did there exist a business, the effect of which is to poison, degrade and ruin humanity! I am not appalled by the thought that prison cells will be empty and poor-houses abolished, and poverty removed, as a result of the destruction of a business which yields two hundred and fifty million dollars a year of revenue, and employs thousands of men in brewing, distilling, transporting and selling distilled liquors.

COMMON DESIRE FOR STIMULANTS.

At the same time one should not quite forget the universal liking of mankind for stimulants. There might be some happy compromise in this matter, and yet it is dangerous to compromise with the devil. He is more than likely to get the better of you, while you think you are winning your own point. The manufacturer of pure beer,— I mean by that a beverage made of malted barley and hops,— and the manufacture and sale of pure wine,— and I mean by that a beverage made solely of the fermented juice of the grape,— might still be permitted without great danger to humanity. It is the distilled liquor which does the damage, as a rule. If prohibition of all kinds of alcoholic beverages is not possible at the present time, what an inestimable blessing would be bestowed upon humanity if the manufacture and sale of distilled beverages were utterly abolished!

SOBRIETY A BENEFIT TO AGRICULTURE.

The benefit to agriculture in such localities as those in which I live would be immense, and the poverty and suffering which I so often see would be abolished, if we could get rid of the distilled beverages at once. There would be little danger of shipping enough pure wine or pure beer to make any farm laborer spend the whole of his week's wages and be unfit for work for a third of the next week. I said to my foreman, who had had experience with a number of week-end drunkards, "When next you are hiring a hand, make particular inquiry if he uses distilled spirits in any form or manner, and if he does, do not hire him to work on my place." The railroads are now enforcing a rule which forbids them to employ or keep in their employ any man who frequents a saloon or uses intoxicating beverages. The farm is as much in danger as the railway train. It would have an excellent influence upon agriculture in general if farmers would band together and refuse to employ any laborer who is even partially a drunkard. When those who drink intoxicating liquors find that there are no avenues of employment left open to them, there will be established an argument for sobriety which is powerful and efficient.

I was greatly surprised, as well as delighted, a year ago when the State of West Virginia, composed as it is largely of a foreign population engaged in mining, voted by a large majority for state-wide prohibition. When I inquired of a citizen in regard to the matter, saying I thought that the miners to a man would vote against this amendment, he replied, "The miners almost to a man voted in favor of it." And when I said, "Do they not use beer and wine?" "Yes," he said, "they do, and if these were the only things on sale in the State they probably would have voted the other way, but the miners themselves realized that the greatest danger which threatened them was the use of distilled beverages, and so they joined almost unanimously in favoring state-wide prohibition." As I read the last galley proofs of this book on this good twenty-third day of September, 1914, the good news has come that Old Virginia has voted for state-wide prohibition by nearly 40,000 majority! God be praised!

SOUTH VS. NORTH.

I have often been asked why it is that prohibition is more popular in the South than it is in the North, and the reasons which I have heard are of the same character as those mentioned above. The negro is more prone to become a victim of the alcohol habit than the white man. As the beverages which are sold to the negroes are the lowest and cheapest of their kind, made of alcohol, coloring and flavoring materials, and designated as "nigger whiskey," the effects which are produced upon the colored man who drinks this material are something fearful. He becomes more of a beast than a human being, and the white people of the South who do the voting, although many of them are users to some degree of alcoholic beverages, have gladly voted for prohibition in order to protect themselves and the States from annihilation.

AN ARGUMENT FOR EQUAL SUFFRAGE.

One argument in favor of conferring the suffrage upon woman is that she will aid her brother in establishing state-wide and nation-wide prohibition. Whether this is so or not, I am unable to say. Statistics are unreliable. I would infer from all the circumstances that the woman would be a prohibitionist, because she suffers more than her husband from his drunkenness. Her love of him and of her children and of herself would lead her to the polls to vote for prohibition.

It is true that there might be some little embarrassment in diplomatic circles if the country were wholly and really dry; but the amenities of diplomacy, it seems to me, would soon find some way to surmount this vaunted objection to official prohibition. We rejoice that we have a president and a cabinet who are altogether sober and serious-minded, not one of whom is addicted to the use of intoxicating beverages and many of whom are strongly in favor of nation-wide prohibition. This at least is a mark of progress, and perhaps I may yet live to be able to conduct my farm, and my neighbors to do the same, without the curse of drunkenness brooding over us from Saturday night to Tuesday morning.

THE HIRED HAND NOT WHOLLY TO BLAME.

What a glorious thing it would be for this country if there was a Webb law which really forbade and prevented the shipment of intoxicating liquors into dry territory. Unfortunately under the present conditions, if these packages are shipped to individuals and not intended for sale, they are not contraband. It would be difficult to compute the injury which is done to this one county of Loudoun by the rotten intoxicants that are shipped into it on Saturday night.

But somehow I can hardly find it in my heart to blame the poor workman. Rather do I blame those who make and ship this deadly poison, and our laws and lawmakers who permit such a dreadful commerce. If you look at it from the inside, there is not much in the farm laborer's life. From sun to sun he is supposed to be engaged in hard labor, with only an hour and a half intermission at noon. He has no stimulus of literature, no enthusiasm of poetry, there are no moving pictures, no plays. He doesn't get to go fishing, nor hunting, nor to join in the local ball game, if there be one. His life is a dreary round of unskilled labor, performed with indifference. The only joy he knows, perhaps, is the intoxication that comes with the insidious alcohol, which brings also temporary forgetfulness of poverty and fatigue.

XI

IS THE SMALL FARMER TO DISAPPEAR?

AS I have studied from time to time the practical problems which present themselves to the farmer above fifty, visions of disaster to the small farmer have presented themselves. It is a question with me whether the small farmer,—I mean by that the man with, say, one hundred or one hundred and fifty acres of land, —is going to be able to persist. In other words, I see the indications of the establishment in the United States, as it grows older, of certain class distinctions, that have grown up, in so far as I know, in all the old countries of the world. These signs may be deceptive, but they are at least alarming.

The vision which is now before me is that of a proprietary class, and practically a peasant class. I have already described the farm laborer of Virginia, belonging, as he does, to a class which is apparently without ambition. The young man as he graduates to his majority passes at once to the position of a farm laborer, and most surprisingly with no ambition to be anything else. When I offered to my head farmer a proposition to become interested in the output of the land, in other words, to begin as a tenant, his answer to me was characteristic. He said, "I have all I can eat and wear, why should I want more?"

THE LORD OF THE MANOR.

If farm labor is to become hereditary, it cannot fail of producing a distinct type of citizen, which in all respects is equivalent to the landless peasant type of the old world. Of course the existence of a type like this necessitates the existence of the lord of the manor, or the proprietor. There is scarcely any kind of farm labor except that which is known as "chores," which cannot be more economically done on a large than a small scale. The plains of the Virginia valleys could easily be plowed by traction power if the fields were made somewhat larger. Of course there are areas where the ground is so stony, both in the Shenandoah Valley and in the Loudoun Valley, that traction plowing is out of the question, but these areas are comparatively small. On my own farm, as far as the arable land is concerned, I imagine that four-fifths of it could now be plowed by a traction engine, and a good part of the rest might have the loose stones removed so as to make such plowing practical. In the harvesting of the crops, also, the self-loader and the hay fork are already supplementing the reaper and binder in making the harvest one of large dimensions and economically conducted rather than the saving of a small crop by the old hand methods. It is only the harvesting of Indian corn which so far has barred the progress of improvement in agricultural implements. The harvesting of the Indian corn to-day is practically the same as that conducted a hundred years ago. Either the corn is gathered after drying upon the stalks in the fields, or the corn, while still green, is cut and shocked and afterwards husked by hand. I have just introduced on my farm a corn harvester which cuts and binds the stalks into bundles of convenient size. It apparently gives satisfaction for corn drilled for ensilage, but is not so time-saving when grown in hills for cultivation both ways.

The existence of improved machinery, especially of the traction plow, would also be economical in diminishing the number of working horses and mules required. I have made a somewhat accurate computation of the cost of keeping a working horse or mule a year, and it is not to be forgotten that the horse or mule must be fed every day whether it works or is idle. The winter and the needs of the farm permit the horse or the mule to be idle almost, if not quite, half the time. The hay and oats and Indian corn necessary to keep a working animal in good condition cost not less than fifteen cents a day for the entire year. In round numbers, then, it costs from $55 to $60 to feed a working horse or mule a year. This does not include the attention which is given in the way of currying, carrying out the manure, keeping the harness, et cetera. Two horses or mules are necessary for every fifty acres under cultivation. A man with one hundred acres, therefore, must keep at least four working animals, and the cost of keeping these animals is pretty close to $250 a year.

On the other hand, the traction engine eats only when it works, and while it costs a great deal more per day, the traction engine will probably not be employed over forty or fifty days a year, hardly that long. So that upon the whole, it becomes less expensive to use this kind of labor than it does that of horses or mules.

THE ADVANCING PRICE OF LAND.

Again, I see in the advancing price of land greater difficulties towards the acquirement of small holdings. There is a distinct tendency, in my opinion, to larger agricultural holdings, and that means the development of the agricultural farm labor class, which to my mind is greatly to be deplored. If we are to have a democracy in this country, it should be a democracy of equal rank and equal privileges, and not a democracy composed of different classes of democrats, as is the case in England and even in France. In this latter country, however, there is one supreme advantage, namely, the principle of small holdings is so thoroughly established that there is little danger of its being crowded out by the methods of extensive proprietary farming.

I have already alluded to the fact that farm labor is very poorly paid in the State of Virginia. This is probably true of other States. The only excuse for that, also, as I have already noted, is the fact that farm labor is unskilled, and much of it does not deserve even the wages that are paid. But the demand for increased wages is insistent and must be dominant. The trades-unions, while they have not invaded the farm laborers, have sent their influence ahead. I do not know that it is right to work a farm hand on the twenty-first of June from twenty-two minutes past four, when the sun rises, to seven-thirty, when it sets; but when you consider that on the twenty-first of December this same farm hand, perhaps hired by the year, works only about four hours,— and that in feeding the farm animals,— you can see that the labor question evens itself up, because the farm laborer hired by the year is paid the same rate in the winter as in the summer. If he didn't work from twelve to fourteen hours a day in the summer, the average day of the farm laborer would not be more than six or seven hours.

The proprietor, therefore, must face the problem of paying higher wages and securing shorter hours of service. This spirit of recognizing the laboring man as a human being is not to be denied, and I would be the last one to seek to deny it. But when this is done, the farm laborer must become more efficient and do better service while he is employed, or else proprietary farming is also doomed.

ADVANTAGES OF LABOR SAVING MACHINERY.

The use of various kinds of machinery for lessening the burden of labor has a two-fold advantage. In the first place it cheapens the production of the crop, by introducing economies into the cultivation and handling and in the second place it has a salutary effect upon the laborers themselves. I have noticed that the laboring man, as a rule, on the farm works much more earnestly and cheerfully in connection with some kind of machinery than he does when depending solely upon his own exertions for the effect produced. The big farm, therefore, with its reapers and binders, corn harvesters, gang plows, traction engines, thrashing machines, and ensilage cutters, becomes a kind of a social center, and in fact is a village. This makes the farm laboring man much more contented and much more efficient.

The human animal is gregarious even in his physical exertions, and a group of men work better together than scattered around at different points. When I have five acres of potatoes to cultivate with the hoe, and have five men to do the job, if I put them all abreast, each one in his own row, they will hoe over a greater area and do a better job than if they are split up one by one and allowed no communication. Hence the proprietary farmer who employs a dozen or more hands is certain to have a more contented body of laboring men, more cheerful and more efficient, than the small farmer who hires a single individual who works by himself.

UNIVERSAL CONDITION OF LANDLORD AND LABORER DEPLORED.

Yet if, as a result of all these natural causes, this country should drift into a nation of proprietary farmers and farm laborers, it would be a matter of sincere regret from the human standpoint. If our people are to be wedded to the soil, how much better it would be for everybody, it seems to me, save perhaps financially, to have our lands broken up into small holdings of ten, fifteen or twenty-five acres, so that each individual workman might have a plot of land of his own and thus the farm laborer become a small proprietor taking a direct interest in his fields. There is no doubt of the fact that it would be good for the fields, and I think there is little doubt of the fact that it would be good for the farm laborer.

The civic center might still be retained, as it is in the European small village, and a group of farmers could build their houses near together, as I have already suggested, and thus have the benefit of incipient social service. This service might be very much extended. The country is now covered with intelligent and educated men and women who are engaged in the farm extension service. It would be an easy matter for them to engage, also, in the extension of social service to the farmers. A common meeting hall might be provided, which would be a kind of a club-house, where the farm magazines could be kept, agricultural literature distributed, and perhaps some simple games of tennis or billiards indulged in. If these centers were so situated as to be accessible to a large number of farmers, the dreadful isolation of the farm life would be to this degree remedied.

I am not a prophet, although I see visions of the future. But these visions are confused like the visions of a dream. They are not clearly limned, and I see one problem merging into another, and two conditions of life coalescing; and the light of the vision is not intense enough to see the final settlement of all these conflicting elements. My hope is that there may be developed in this country millions of land owners, so-called, who have a personal interest in the body of land on which they live, who care for it as they would care for their horse or their child, who take a delight in the fertility of the fields and know the methods of maintaining it, who are not ambitious for high social or political preferment, but are ambitious to lead clean, wholesome and useful lives of industry, and who, in the association of their neighbors and friends, may no longer be isolated, but may have, in enduring the toil of the farmer, the privileges of social advancement and association.

And yet this vision, which it seems to me would be the ideal one of the future, is clouded with that other mist of the landed proprietor, with his hundreds or thousands of acres, with his huge machines for plowing and cultivating and harvesting, living perhaps in a palace, and surrounded with the huts of peasants, men who have no interest whatever in the soil itself, but who live simply to have enough to eat and something to wear. There may be a few middlemen by means of which these two conditions may partly coalesce, but to my mind the tendency is either one way or the other.

Farming, then, will not only become a science but a business, as clearly defined as manufacturing or distribution, and there will be farmer princes and captains of industry, as there are to-day in manufacturing,

CHURNING BUTTER

STACKING THE OAT STRAW

distribution and banking. The man of fifty who goes upon a farm will also be a man of wealth, and he will not go upon the farm as a business proposition, but as a luxury. The actual proprietor of the farm will be born and bred to his trade, educated for it, enter it when he is young and stick to it, if he succeeds, until he dies. And yet this is the most serious question of all: Does the future afford no promise for the farm laborer?

XII

THE PLACE OF THE FARMER IN THE SOCIAL SCALE

IT cannot be denied that there is a feeling, however just or unjust it may be, that the farmer of the past, and even of to-day, belongs to an inferior rank. This feeling, of course, is not entertained by men and women of culture and of broad views, but it is a common theme exploited by the so-called wit and cartoonist. The farmer is pictured, in the comic papers especially, as the easy victim of the sharper and the faker. In point of fact he is also the victim of the lightning rod seller, the book seller and the nostrum purveyor.

The character of advertisements carried in farm journals is not always of a kind to elevate, ennoble and purify country life. The baldest schemes of curing all diseases, of furnishing wonderful seeds, of securing insurance, of fabulous profits from certain crops, and other means of taking advantage of the unwary and the unsuspecting, are exploited to a greater degree in the country than even in the city. While it is probably true that the farmer with his average intelligence ranks well up in the scale of social existence, it is true also that by his lack of experience of men and affairs he is less prone to suspect and therefore more open to approach than his brother who has become used to the wiles of the city.

THE FARMER EXPLOITED POLITICALLY.

The farmer has also been exploited as a class for political purposes. Appeals are made directly to the farmer as a separate class of society. Laws are passed presumably for his benefit, which are often for his injury. It is a notorious fact that in a farming and dairying community it is almost impossible to get rigid laws covering the inspection and commerce in dairy products. In some of the farming States where the dairy industry is dominant, the legal standard for milk is fixed at three per cent. of fat, whereas it is well known that the average fat content of American milk is not less than four per cent. Sanitary laws, looking to the cleaning up of the dairies and the pig pens and the stables in the country, and to a proper sanitation of the water supply, looking to the control of typhoid fever and other contagious and infectious diseases, are not only difficult to enact in a country community, but still more difficult to enforce.

The farmer is credited, moreover, with being a conservative, when in point of fact mere inertia is mistaken for conservatism. It is difficult to get a farming community to vote for good roads, and I am not surprised at this, because in the construction of good roads such palpable frauds have been so frequently committed upon the tax payer.

The farmer is also charged with packing the best apples on top of the barrel, and putting the biggest berries in the top layer of the box. These charges perhaps do not lie with any greater pertinence against the farmer than they do against those in other lines of business practising similar kinds of deception.

THE THREAT OF SOCIAL CLASSIFICATION.

I look upon the attempt to classify American citizens, by reason of occupational pursuits, into different strata of social efficiency and honor, as extremely perilous, unwise, and threatening to the fundamental principles of democracy. A man should not be classed socially by reason of his employment. If there are to be distinctions of a social character, they should rest upon individual merit and accomplishment, and not upon the accident of profession. The officers of the army, whose business in time of war is to direct the most efficient machine for killing human beings, rank proverbially high socially. The farmers who follow the plow and make the crops which lie at the very foundation of national prosperity and growth, occupy a very inferior position in the social order. Even the makers of political platforms are not slow to single out occupational classes in their bidding for votes. When it comes to voting the farmer and the laboring man are the real aristocrats, and the dangerous habit is growing up of modifying legislation to suit the particular demands of a class, such as the laborer or the farmer, without reference to its intrinsic merit or ethical foundation. This is not peculiar to the United States. Other countries are troubled with agrarian agitation and the passage of agrarian laws particularly for the protection and benefit of the farmer.

To my mind the farmer is an American citizen. He is entitled to the same rights and privileges as every other citizen. He is not entitled to any more. He should not ask any more. The politician who wants to give him more is not a statesman, but a demagogue. The law which gives him more is not sound in its legislative heart. It has the dry rot. It threatens to infect the whole legal code. It is class legislation, which in its very nature is vicious and in its enforcement calamitous. The political ambition of the farmer should be to enjoy the rights of citizenship.

"ORCHARD'S WHERE I'D RUTHER BE"

Photo by U. S. Dept. of Agriculture

THE PEACH TREE BORER

THE FARMER'S UNION.

The farmer, as is the case with every other realm of human activity, has the right to organize for his own betterment and for his own advancement, but this organization is not for the purpose of selfish interests, nor should the good that comes from it be at the expense of any other group of citizens. Agriculture can prosper only as all other industries prosper. To be sure, it is the fundamental industry. The other industries could not exist without agriculture, but it would be a poor kind of a country in which agriculture was the only industry. I believe that all groups of activities are thus mutually interdependent, and no one of them should be exploited at the expense of the welfare of any other.

If the fundamental principle of the American government is correct, namely, that the citizen unit is equal before the law in all parts of the country, then these attempts at class segregation must be fundamentally in opposition to the organic principle on which the nation is founded. The farmer of the present and the future will therefore have power and influence in proportion to his merit, his education, and his devotion to the public service, and this is all the power and influence that any man should possess.

Personally I believe that agriculture is the fundamental profession, that it is one in which a man can have greater opportunities for development, have broader views of life and render more efficient service, than in any other activity in which man engages. But much depends upon the point of view. There may be carried into agriculture the same selfish principles that have made commerce synonymous with greed and Wall

Street synonymous with robbery; but that is not the kind of agriculture that I have in view. On the farm alone a human unit can come into real communion with nature. In the fields he sees illustrated better than anywhere else the unalterable laws of nature working for the benefit of humanity. In the forest he can sit with the trees and God as his auditors and discourse upon life as he can in no other environment. The rising of the sun inspires him, the gathering of the storm awes him, the beauty of nature charms him, the joy of life consoles him. I cannot get it out of my mind that the natural must in all cases be superior to the artificial. I cannot escape from the belief that the man who lives in closest touch with nature, other things being equal, will be the best man and have the broadest view of human life, human activity and human destiny.

THE FARMER OF THE FUTURE.

The farmer of the future, if he develops in accordance with the views which I have tried to express, will be the leader of thought, the expounder of the true philosophy, and the conserver of wholesome politics for the nation. When I go on the East Side of New York and look upon human life as it exists in those crowded tenements, and upon human activity as it goes from the dingy rooms of the tenement house to the seething heat of the factory, without a glimpse of the sky or a patch of green, I despair of the country. I cannot conceive of this country prospering and growing and leading nations when peopled by those who live in such an environment. On the contrary, when I go into the peaceful regions of country life and look upon the farmer at the plow, or in the garden, or in the forest, when I see nature springing into bounteous life in May and yielding an equally bounteous harvest in October, I then have faith in the future.

This is one of the chief reasons why I would make the country more attractive than the city, so that country life would be the ambition, the very highest ambition, of the American citizen. In such a condition of affairs I see no danger to the institutions of our land. On the contrary, I see those foundations which are eternal and on which the permanent civil structure of government can be erected. I see a land of peace, and yet of positive action; a land of plenty, and yet not one of luxury; a land of contentment, instead of a seething mass of strikes, turmoils and *émeutes*. I see no one class of our people arrayed against another, but all of our people in one class, namely, patriotic citizens, each in his way striving for the benefit of himself, his family and his native country. I do not see the struggle of one class against another to wrest the activities of the government. I do not see a president elected because he is a farmer, a lawyer, a laboring man, a minister of the gospel, or a college professor. But I see a country where those who occupy the offices are the true servants of the people whom they serve, and who are elevated to the positions they occupy solely upon individual merit, and not by reason of class affiliation. Such a condition as this is the one which we all should strive to attain. To do this agriculture must be made more attractive. The great cities must be to a certain extent depopulated, and the people of our country must live nearer to nature.

XIII

THE FARMER'S MARKET

IT is important that crops should be grown, and in a profitable manner. The good farmer not only increases from year to year the magnitude of his crop, but leaves to his heir a more fertile field than he found. Any system of agriculture, which leaves an impoverished field, is essentially immoral as well as unprofitable. A farmer not only needs food and clothing for himself and family, but he of necessity must sell a certain portion of his products. Taxes are to be paid, improvements made, articles not grown on the farm purchased, and something put by for a rainy day.

Theoretically a farmer should sell those things which do not carry off with them the fertility of the soil. Ideal things to be sold are cotton, butter and sugar. These agricultural products do not carry with them any appreciable quantity of plant food. A farmer might sell a million tons of sugar and not carry a ton of plant food away from his farm. He can do almost as well selling cotton and butter. On the other hand, when he sells milk, wheat, Indian corn and hay, or when he drives away from his farm flocks and herds, he carries away large quantities of potash, phosphorus and nitrogen. In other words he sells plant foods, and these have to be restored to the soil in some form or other.

It is not quite possible for farmers to sell only the ideal substances mentioned above. He necessarily must dispose of other things, else the rest of the world would starve. Therefore we must face with philosophic resignation the yearly necessity of disposing of the very cream of our fields. In doing this does the farmer have a fair chance? I think the answer is emphatically "No."

The reasons of the disadvantages in which the farmer finds himself are not hard to find. First is his pitiful degree of isolation. When a farmer approaches the market he goes out singly, as a soldier would by himself to battle. The result is that he becomes the victim of every organized form of greed. On the contrary, when he buys anything, he buys of an organized industry, which knows how to protect its product and secure the highest price. The farmer's market, therefore, is tied at both ends. The pitiable helplessness of the farmer in the market ties his end of it; the organized foresight of the market from which he buys, ties the other end. The result of both of these restrictions is that the farmer does not get a fair share of the money that is expended finally for his products.

It is difficult, of course, to determine what the final expenditure is; in other words, what the consumer pays for bread, meat, fruit, vegetables and clothing, the things the farmer produces. Of one thing we may be certain, and that is that the final price which is paid is many times higher than what the farmer gets. No one complains of this condition of affairs. It costs money to bring the farmer's products to the consumer's home, and that cost, with a fair profit thereon, is a legitimate tax upon the farmer's products, paid partly by the consumer and contributed partly by the farmer. Too many middlemen spoil the farmers' broth.

THE NECESSITY OF TRANSPORTATION FACILITIES.

I am not one of those who denounce the railway for proper charges, nor the necessary middleman for reasonable profits. When I send a bushel of flour from my farm fifty miles away to Washington and pay twelve cents freight, I do not consider that I am robbed; but when I pay the city transportation company seventy-five cents to deliver that package at my house, I am robbed, but the railroad is not the robber. If I offer my goods for sale to a middle party and he charges me six per cent. commission, if he gives me an honest deal I do not consider that I have been defrauded. When I sell my product to the buyer and he re-sells it the next day at a profit of thirty per cent., I am robbed. He makes more in a day out of my year's work than I make in a year.

It is easy to state the conditions of trade, but it is not by any means so easy to suggest a better way therein. I can best illustrate by transactions which I have just had. The small farmer is in no position to ship his beef cattle to a market and take the chances of their sale. He is not a large enough dealer to know how to protect even his own interests, and the farmer with his cattle on the market far from home is at the mercy of the bidder.

The practice in my part of the country is as follows: When the beef cattle are ready for the market you are visited by a number of buyers. As they look over your stock of cattle, they shoot it full of holes. This steer is too slender in the flank, the next has a sway back, the third shows its ribs too plainly, and the fourth and fifth have grave defects. In fact, the beautiful herd of cattle that you so admired before the buyer came along, shrivels up in your sight so that you feel ashamed of owning it before he gets through his criticisms. Of course these criticisms are far from being true, but not being an expert yourself, you do not know how to meet them. He asks you a price and you name what you think you should have and no more. He names, in reply, a price fifteen or twenty per cent. less. You become a helpless victim to his critical study of your herd. You refuse his offer. Another buyer comes and the same program is enacted. Even a third or fourth may come. By this time you realize that you are helpless. You must either take the chances of shipping the cattle yourself and thus becoming a helpless victim far from home, or of surrendering at discretion. You will find so little difference in the various offers that you are almost led to believe that the buyers are in a trust and are leagued together for the purpose of forcing the price down.

In the particular instance to which I refer, my steers were of a very fine quality. They weighed even heavier than I had anticipated, having an average weight of 1,315 pounds. In Chicago on the day that I sold my cattle, steers of this weight were selling at from 8.75 to 9.25 cents a pound. A thousand miles east of Chicago the market would naturally be higher. For instance, in an untied market like that of wheat, where the standard price is well known, the price per bushel in Baltimore is from 4 to 6 cents higher than in Chicago. On the twelfth of September, when I sold my fat cattle, I should have received a higher price than 9 cents a pound. In point of fact, I sold one steer for 8 cents a pound and 32 for $7\frac{6}{10}$ cents per pound. Of course I have no means of knowing what profit the broker made on these steers, but it seems perfectly certain to me that, knowing the market and understanding how to pull all the strings, he must have made from 4 to 26 dollars a head on each one of them. How I wish I could have heard him when he came to sell them! Those very steers, so deformed, so spavined, so thin of shank and sharp of back, blossomed out into fully rounded, perfectly formed, top of the market cattle, when presented to the butcher at the shambles!

A more striking example was that of the sheep which I disposed of on the same day. The buyer would not buy the sheep outright, but said he would sell them for me on commission. I had to pay for loading them on the cars, and for this purpose had to keep two men a whole day waiting for a car. In addition to that, however, I was charged at the rate of $40 a ton for hay that was fed them in transit. Forty dollars a ton for hay that I would gladly sell at the present market price for $15 a ton, shows just about the difference between the farmer's market when he buys and the farmer's market when he sells. Of the sheep sold, 17 were lambs, for which I got 6 cents a pound; 88 were yearling ewes in fine condition, for which I got $4.50 a hundred pounds; 45 were old ewes, for which I got $3.12½ a hundred pounds. As a farmer, if I should go to the market and buy the lamb chops, or the legs of mutton, from all except the 45 old ewes, I would pay from 18 to 30 cents a pound for the meat. These are conditions which are intolerable, and yet which I do not know how to remedy. You can imagine from this recital that sheep growing for mutton purposes is not a very pronounced success. I feel certain that my own experience is that of the great majority of farmers. If the farmer by chance can get in touch with the maker of the goods he buys, he has to pay the local agent a commission.

Photo by U. S. Dept. of Agriculture

RAVAGES OF THE SAN JOSE SCALE

Lime-sulphur spraying outfit

Photo by U S. Dept. of Agriculture

SPRAYING OUTFIT AND MIXING PLATFORM

WHAT PER CENT. DOES THE FARMER GET?

I do not believe that farmers are entitled to more than they ought to have, but there is a huge gap in most of the necessities of life between the farmer's selling price and the consumer's paying price. Perhaps an illustration which will be best understood is that of milk. The farmer in my part of the community gets about 14 cents a gallon for his summer milk, the railway charges, perhaps, are not to exceed 2 cents a gallon. Good milk sells at retail in the city of Washington for 40 cents, common milk for 36 cents and certified milk at 80 cents a gallon. A simple computation will show that the farmer who spends all of his time and his talent in producing ordinary milk, gets 33 per cent. of the price the consumer pays for his product. The capital invested in a milk distributing plant is extremely small as compared with the capital invested in a farm and dairy. The milk distributor turns his money over every day; the farmer gets one profit for the year.

The picture indeed is dark, but there are some bright spots in it. The farmer who sells wheat gets a much larger part of the consumer's price than the farmer who sells milk or cattle. In other words, the price of flour is not by any means 70 per cent. higher than the price of wheat, but this peculiar thing happens to the farmers in my vicinity in regard to wheat. Loudoun County, Virginia, is a great producer of wheat and corn. As a rule the wheat is rushed into market soon after it is thrashed, or within a short time thereafter. As soon as the wheat crop is on the market there is always a very decided fall in prices. A tenant on one of my farms last year sold his wheat for 84 cents a bushel; I kept my wheat, of no better quality, three or four months and sold it for $1.04 a bushel, 20 cents more than my tenant received.

But this is not the most striking illustration of bad management on the part of the farmer in handling his markets. Not only do they sell their wheat, but they sell it all, and before the next harvest begins they are buying flour. I have repeatedly seen packages of flour in the village having come as far as from Minnesota. The miller at Bluemont tells me that in the spring he orders wheat from the Northwest to grind to fill the local demand. Thus, in the autumn almost all the wheat in the country is shipped out, and in the spring the necessary supplies for the farmers' uses are shipped back. This catches the farmer coming and catches him going.

THE FINAL RESULT.

The obvious conclusion from this brief statement of the fundamentally wrong conditions of the market is that in all matters controlled by trusts the farmer has no show at all. For instance, the meat markets of this country are in the hands of a few individuals and the farmer sells his meat at a forced low price. On the other hand, the wheat markets of the country are too large to be controlled by a trust, and the farmer gets a fair market price for his wheat.

It would hardly be fair to go into these details without some suggestion of a constructive nature. The most obvious fact, as I see it, is that the farmer will never come into his full rights in the market until he is thoroughly organized. I say this with a full knowledge of the financial shipwrecks which usually attend any ventures at coöperation, and yet successful coöperation is the only way to meet successful organization.

The neighborhood warehouse for any non-perishable goods such as cereals, seems to me to be one avenue that is open; but unfortunately such a warehouse would only contain those things in the sale of which the farmer suffers least. How shall the farmer control the market for his live stock used for food purposes? That is the most difficult problem. The products of the farm must go to the consumer. One possible way, if it could be adopted, would be to have the farmers of a county establish a market in the city where they could sell directly to the consumer. I know the dangers of such an undertaking, the difficulties of securing the proper men, the dangers of financial stress and loss, the lack of business sagacity which the representative of the farmer might display, the opportunities for peculation and theft, and in fact a whole array of difficulties which can be easily stated and which are without doubt threatening; but at least in such an organization there could be a cold storage warehouse, and the farmer would not be so completely under the thumb of the trust and the manipulator.

XIV

THE FARMER AND THE PARCEL POST

ON the Pennsylvania Railway en route from Philadelphia to Washington, on the twenty-second of June, 1914, I fell into conversation with a gentleman who owns a farm twelve miles from Fredericksburg, Virginia. Gossiping about the various things connected with farm life, I discovered that he had established a small dairy. He told me he had been North to examine various appliances looking to the shipment of dairy products by parcel post. Living, as he does, twelve miles from the railway station, the daily delivery of milk for consumption in Fredericksburg, Richmond, or Washington, is a task of great magnitude. The idea which was in his mind was that if he could ship cream by parcel post, he might secure a profitable market for his dairy products and at the same time retain the skimmed milk for feeding to pigs and young calves.

Experience has shown that the shipment of cream to butter factories in the large cities — there are none other in this part of the country — is altogether unprofitable to the farmer. At the prices which are paid, which at the best amount to about twenty-four or twenty-five cents per pound of butter-fat, the farmer cannot make expenses. It requires nearly twenty-five pounds of milk to make one pound of butter-fat, and this amounts to only a little over a cent a pound for

THRASHING HANDS

'The farm laborer should be treated as a human being, and not as a neglected agricultural implement" the milk. It is true that the skimmed milk is still available for the farmer's use, but the price of skimmed milk does not exceed, as a rule, a quarter of a cent a pound. Thus, for twenty-five pounds of milk the farmer at most could not get more than thirty cents. A cow giving twenty-five pounds of milk will require fully twenty cents' worth of food per day. Add to this the care of the animal, interest on the investment, depreciation and charge of shipping, and the farmer comes out in debt every day.

If, however, the farmer could secure, through the parcel post, a clientele for his butter or his cream, he would be able to pay expenses and even make a small profit. The retail price of good creamery butter in Washington averages about thirty-five cents the year around. Creamery butter is only 82 per cent. butter-fat. Twenty-five pounds of milk would make almost one and a quarter pounds of butter, and this, at the price mentioned above, would bring a gross income of about forty-four cents for the twenty-five pounds of milk, and still leave the food value of the milk for the farmer's use.

Inquiring further as to what result had come from his visit, he said that he had found a paper package guaranteed to be acceptable to the parcel post, which could be had in large quantities at a very cheap rate, probably not over three or four cents for a gallon package. A gallon of cream, however, is too much to send to any individual customer other than a restaurant or a hotel. The maximum cream package for general use among families would probably not hold over four pounds. Cream properly chilled and sent promptly by parcel post, and on arrival placed in cold storage, can easily be kept two or even three days without pasteurization. If well pasteurized it might keep even longer than this. In such conditions the sending of a package of cream by parcel post to a family of somewhat large size would be commercially practical.

The package of course would not be used again, and that seems to be the unfortunate part of it. Even if it were a permanent package, the return would cost a great deal, because the initial price for the first pound by the parcel post is quite high compared with the prices for larger weights. In shipping cream by parcel post, also, a very concentrated article would be produced, known as double cream, containing about forty per cent. of butter-fat. The production of such cream with a good centrifugal separator is easily accomplished. One pound of this kind of cream would therefore be equal to two pounds of ordinary twenty per cent. cream. The sending of butter, of course, by parcel post is a much simpler proposition. The package itself could be cheaper, and the keeping quality of the product is such that a family could easily take five pounds at a time and have practically fresh butter every week. Even certified milk, in a suitable container, might be sent by parcel post.

EARLY SUCCESS NOT EXPECTED.

The success of the parcel post as a means of communication between producer and consumer cannot be expected to be very brilliant at the start. There are many incident problems which can only be worked out in the light of practical experience. Postmaster General Burleson is very much in earnest in making the parcel post an efficient means of communication between farmer and consumer. In this effort he should have the undivided support of all citizens, except those engaged as middlemen in the distribution of food products.

The postmaster at Washington has hit upon a unique plan for bringing to the notice of the consumers the names of farmers who are willing to engage in the parcel post business for agricultural products. To this end the public library of Washington has been secured as a means of publicity. There is posted in the public library a list of farmers within the first and second zones, that is, up to a distance of one hundred and fifty miles, who are willing to come into contact with consumers in the city of Washington in the shipment of food products. Any intending consumer who wishes to get in touch with farmers can get their names and addresses in the public library.

The postmaster at Washington has also prepared a circular to send to intending shippers, giving instructions to the farmers as to how the particular product in question is to be prepared and packed for shipment. Also, there is posted a list of manufacturers of packing boxes and containers for the shipment of farm products by parcel post, and this is also made available to the farmers in order that they may secure the proper kind of packages for their use. In addition to this, a special delivery system has been devised, so that products which come into the city by morning shipments may be distributed at once to the consumer, without lying over for hours waiting for the ordinary delivery to take place. In fact, the Postoffice Department has done everything possible, in so far as knowledge of the problem extends, to inaugurate a service which will be of a practical character, and which promises to develop into a system of mutual benefit to consumer and to farmer.

DIFFICULTIES TO BE OVERCOME.

It would be idle to minimize the difficulties which have to be surmounted. The ordinary farmer has no skill whatever in packing products for transportation. The parcel post will therefore be flooded with articles improperly packed which cannot be legally carried, and which will be left at the depots of transmission unshipped until the owners can call and take them away. My own experience in transmitting food products by parcel post, before the present arrangement referred to went into execution, illustrates this difficulty. I desired to send some white clover honey produced near my farm in Loudoun County to a friend in New York City. It was comb-honey, well preserved, and was packed as well as I knew how, so as to avoid damage and leakage. It started on its journey from Bluemont, Virginia, to New York City. When it reached Washington it was found that the honey had begun to leak out. The package was withdrawn from the mails, and I was notified that it could not be sent any further. This is only a type of the difficulties of properly preparing an article for shipment, by those unskilled in the art of packing, which will have to be surmounted.

In the next place, the consumer will have to order blindly. He will have no opportunity of inspecting the products he purchases before they are bought. This, however, is a difficulty which will be overcome by natural causes. The farmer who ships imperfect or improperly prepared food products will at once lose his customers. Therefore it is self-preservation on his part to ship only articles of good quality and in prime condition. Both consignee and farmer must be helpful and patient until normal working conditions are secured.

HELPFUL ADVICE FROM THE POST OFFICE DEPARTMENT.

A few quotations from the circulars sent out by the Postoffice Department will more fully indicate the purpose which is kept in view and the methods of successfully securing it. Under the caption "Producer and Consumer to be Brought into Closer Touch," the Postoffice Department says:

The Postoffice Department desires to increase the usefulness to the public of the Parcel Post by bringing the consumer and producer in closer touch. Therefore it invites all farmers who desire to sell and ship country produce by parcel post direct to the consumer to send their names and addresses by mail to "Postmaster, Washington, D. C., Produce List." Tell what you have for sale. A postal card may be used for the purpose. When a sufficient number of names are received they will be printed and distributed to persons who would likely make use of such lists. The Washington Public Library, Mount Vernon Square, Washington, D. C., has announced its willingness to coöperate with the farmers and producers in bringing them in direct touch with the city consumers, and to this end will receive and post on the bulletin board in the library the prices at which farmers and others will sell their butter, eggs, or other produce by parcel post.

It is also announced that parcels which weigh over twenty pounds will be carried separately, outside of mail bags, thus insuring more care and less damage to other mail matter, should accident happen. The size and weight of parcels are prescribed as follows:

Packages for the parcel post must not measure more than 72 inches in length and girth combined and must not weigh more than 50 pounds when addressed to a person within the first or second zones, or a distance of not more than about 150 miles. If the package to be shipped is to go more than 150 miles, or beyond the second zone, it must not weigh more than

20 pounds. The postmaster or the mail carrier who will receive your package for mailing, will give you any further information you may desire about the rates and manner of packing your parcels.

In the information sent to farmers the following important items are noted:

Preparation for Mailing.— Farmers intending to ship farm products in considerable quantities should submit to the postmaster at their local post office for approval, a specimen parcel showing the manner of packing. Parcels containing perishable articles should be marked "PERISHABLE." Articles likely to spoil within the time reasonably required for transportation and delivery will not be accepted for mailing.

Butter, lard and perishable articles such as fish, fresh meats, dressed fowls, vegetables, fruits, berries, and articles of a similar nature which decay quickly, when so packed or wrapped as to prevent damage to other mail matter, shall be accepted for local delivery either at the office of mailing or on any rural route starting therefrom. When inclosed in an inner cover and a strong outer cover of wood, metal, heavy corrugated pasteboard, or other suitable material, and wrapped so that nothing can escape from the package, they will be accepted for mailing to all offices to which in the ordinary course of mail they can be sent without spoiling.

Butter, dressed fowls, vegetables, fruits and other perishable articles in parcels weighing more than twenty pounds shall be accepted for mailing to offices in the first and second zones when suitably wrapped or inclosed and packed in crates, boxes or other suitable containers having tight bottoms to prevent the escape of anything from the package and so constructed as properly to protect the contents. All such parcels to be transported outside of mail bags.

Vegetables and fruits which do not decay quickly will be accepted for mailing to any zone if packed so as to prevent damage to other mail matter.

Eggs shall be accepted for local delivery when so packed in a basket or other container as to prevent damage to other mail matter.

Eggs shall be accepted for mailing regardless of distance when each egg is wrapped separately and surrounded with excelsior, cotton or other suitable material and packed in a strong container made of double-face corrugated pasteboard, metal, wood or other suitable material and wrapped so that nothing can escape from the package. All such parcels should be labeled "EGGS."

Eggs in parcels weighing more than twenty pounds shall be accepted for mailing to offices in the first and second zones when packed in crates, boxes, buckets or other containers having tight bottoms to prevent the escape of anything from the package and so constructed as properly to protect the contents. Such packages to be marked "EGGS — THIS SIDE UP," and to be transported outside of mail bags.

Mailable liquids, including preserves, in securely sealed glass bottles or metal cans shall be accepted for mailing when packed in strong boxes and surrounded with other suitable substance to prevent contents from breaking. All such packages to be marked "FRAGILE."

Pastes, salves, etc., not easily liquefiable, shall be accepted for mailing when enclosed in water-tight containers and placed in a strong pasteboard or wooden box.

Mailable hides and pelts shall be thoroughly wrapped to prevent grease soaking through the packing and damaging other mail matter.

Permissible Additions.— You may tie or otherwise securely attach a letter in a sealed envelope to your parcel post package if it bears the same address as the package, but the letter must have on it the regular letter postage and the parcel must have on it the proper amount of postage. It is better, however, to mail your letter and parcel separately. You may place in the parcel a printed circular describing the matter sent, and inclose a printed or written bill for the articles in the parcel. Any other written matter, however, will subject the whole package to the letter postage rate. In addition to the name and address of the sender, which is required, it is permissible to write or print on the covering of a parcel of fourth-class matter, or on a tag or label attached thereto, the occupation of the sender, and to indicate in a small space by means of marks, letters, numbers, names or other brief description, the character of the parcel, but ample space must be left for the full address and for the necessary postage stamps. Inscriptions such as "Merry Christmas," "Please do not open until Christmas," "Happy New Year," "With best Wishes," and the like, may be included inside or placed on the covering of the parcel in such manner as not to interfere with the address.

Insurance.— Parcels on which the postage is fully prepaid may be insured against loss in an amount not exceeding $25 on payment of a fee of 5 cents, and $50 on payment of a fee of 10 cents. A return receipt will be furnished if desired.

Collection on Delivery.— You may send a package C. O. D. by parcel post by attaching an additional 10 cents in postage on the package, provided the amount to be collected by the post office on the package for you is not more than $100, and provided also that the office which mails the package and the one at which it is received are money order offices.

Time of Shipment.— Your postmaster or rural carrier can inform you when is the best time to ship parcels so as to make good connection and promptly reach the office they are addressed to. No delivery of parcels is made on Sundays unless sent by special delivery.

Special Delivery.— Parcels which are fully postage paid will be immediately delivered by the office they are addressed to on an extra payment of 10 cents in postage stamps affixed.

The rates of transmission for the different zones are prescribed as follows:

The rate of postage for parcel post packages is given in the table here printed. The local rate is applicable to parcels of farm products intended for delivery at the office of mailing, including rural routes starting therefrom.

The rate of postage on fourth-class matter (which includes farm produce) weighing not more than four ounces is one cent for each ounce or fraction of an ounce regardless of distance, and on such matter in excess of four ounces in weight, the rate is by the pound, as follows, the postage in all cases to be prepaid by postage stamps affixed:

ZONES

WEIGHT		Local delivery	1st. 50 miles	2d. 50 to 150 miles	3d. 150 to 300 miles	4th. 300 to 600 miles	5th. 600 to 1000 miles	6th. 1000 to 1400 miles	7th. 1400 to 1800 miles	8th. All over 1800 miles
1 pounds	...	0.05	0.05	0.05	0.06	0.07	0.08	0.09	0.11	0.12
2 pounds	...	.06	.06	.06	.08	.11	.14	.17	.21	.24
3 pounds	...	.06	.07	.07	.10	.15	.20	.25	.31	.36
4 pounds	...	.07	.08	.08	.12	.19	.26	.33	.41	.48
5 pounds	...	.07	.09	.09	.14	.23	.32	.41	.51	.60
6 pounds	...	.08	.10	.10	.16	.27	.38	.49	.61	.72
7 pounds	...	.08	.11	.11	.18	.31	.44	.57	.71	.84
8 pounds	...	.09	.12	.12	.20	.35	.50	.65	.81	.96
9 pounds	...	.09	.13	.13	.22	.39	.56	.73	.91	1.08
10 pounds	...	.10	.14	.14	.24	.43	.62	.81	1.01	1.20
11 pounds	...	.10	.15	.15	.26	.47	.68	.89	1.11	1.32
12 pounds	...	.11	.16	.16	.28	.51	.74	.97	1.21	1.44
13 pounds	..	.11	.17	.17	.30	.55	.80	1.05	1.31	1.56
14 pounds	...	.12	.18	.18	.32	.59	.86	1.13	1.41	1.68
15 pounds	...	.12	.19	.19	.34	.63	.92	1.21	1.51	1.80
16 pounds	...	.13	.20	.20	.36	.67	.98	1.29	1.61	1.92
17 pounds	...	.13	.21	.21	.38	.71	1.04	1.37	1.71	2.04
18 pounds	...	.14	.22	.22	.40	.75	1.10	1.45	1.81	2.16
19 pounds	...	.14	.23	.23	.42	.79	1.16	1.53	1.91	2.28
20 pounds	...	.15	.24	.24	.44	.83	1.22	1.61	2.01	2.40
21 pounds	...	.15	.25	.25						
22 pounds	...	.16	.26	.26						
23 pounds	...	.16	.27	.27						
24 pounds	...	.17	.28	.28						
25 pounds	...	.17	.29	.29						
26 pounds	...	.18	.30	.30						
27 pounds	...	.18	.31	.31						
28 pounds	...	.19	.32	.32						
29 pounds	...	.19	.33	.33						
30 pounds	...	.20	.34	.34						
31 pounds	...	.20	.35	.35						
32 pounds	...	.21	.36	.36						
33 pounds	...	.21	.37	.37						
34 pounds	...	.22	.38	.38						
35 pounds	...	.22	.39	.39						
36 pounds	...	.23	.40	.40						
37 pounds	...	.23	.41	.41						
38 pounds	...	.24	.42	.42						
39 pounds	...	.24	.43	.43						
40 pounds	...	.25	.44	.44						
41 pounds	...	.25	.45	.45						
42 pounds	...	.26	.46	.46						
43 pounds	...	.26	.47	.47						
44 pounds	...	.27	.48	.48						
45 pounds	...	.27	.49	.49						
46 pounds	...	.28	.50	.50						
47 pounds	...	.28	.51	.51						
48 pounds	...	.29	.52	.52						
49 pounds	...	.29	.53	.53						
50 pounds	...	.30	.54	.54						

Send your name and address to the Postmaster, Washington, D. C., if you want to sell your produce by Parcel Post, *and tell what you have for sale.*

Keep this Circular for reference.

The placards which have been posted in the public library at Washington have attracted a great deal of attention from visitors. The Postoffice Department has also established relations with existing organizations in Washington whose purpose is the betterment of household conditions. Particularly have they established a system of coöperation with the Housekeepers' Alliance of Washington. In regard to this coöperation the Postoffice authorities make the following statements:

It is realized that the method of shopping, by sending the market basket direct to the farm, is to some extent experimental with both the consumer and the farmer, and for this reason the *Housekeepers' Alliance of Washington* has consented to cooperate with the Washington Post Office to the extent of trying out as many farmers as possible, with the view of determing the following points: First, whether the business methods of the farmers make it practicable to deal direct with the producer; second, whether the method of packing, character of produce and intelligence shown in mailing, meet the requirements of the city consumer; third, whether the transportation service by the Post Office Department and the Washington Post Office insures delivery of parcel post matter in fresh and satisfactory condition.

In order to arrive at a fair determination of these matters and to be able to render a practical service to the consumers of Washington generally, the Housekeepers' Alliance desires to have sent to Committee on Coöperation, Housekeepers' Alliance, P. O. Box 476, Washington, D. C., by postal card or letter, a specific report by any person in the city who has had parcel post experience, answering the following questions:

(1) Name and address of farmer.

(2) Articles purchased and prices paid for them.

(3) Who (farmer or consumer) furnished the container and how well were the products packed.

(4) Was the farmer's service prompt and satisfactory.

(5) In what condition did parcels arrive and how promptly were they delivered by the post office.

(6) Remarks.

In order to cover as many sections of the country, as many farmers, and as many separate shipments as possible, the Housekeepers' Alliance will receive answers to the foregoing questions from all who desire to thus coöperate with it.

The organization will collate this information and place the results before the city consumer, as well as the farmer, for the information and guidance of each.

Quotations by farmers for their products will continue to be found posted on the bulletin board of the *Public Library, Mount Vernon Square* in this city.

The purpose of this undertaking by the Post Office Department, with the coöperation of public-spirited persons and institutions, is to bring the city consumer and country producer together through the facilities offered by the parcel post. This consists of a very simple proceeding. After you have written to a farmer on this list, or any other farmer whose address you have learned from some acquaintance, and have made arrangements as to the price and payment for the articles you want to buy, take a strong market basket with a cover or a double corrugated paste-board mailing box, and send it to the farmer. If it weighs a pound it will cost 5 cents to mail it to the farmer empty; if between two and three pounds, it will cost 7 cents to mail. Double corrugated shipping boxes of various types can be purchased very cheaply from paper stores and market supply houses in Washington.

When you have found a satisfactory farmer to deal with, shopping by parcel post becomes a simple process of sending your market basket to the farm with a letter telling what you want. The cost of that process is just a little less than if you got on a street car and rode down town and back, and just a trifle more than if you ordered what you wanted over the telephone. You can mail your empty basket at any drug-store postal station. The parcel post brings the filled basket to your door. This simple process of sending an ordinary, strong, market basket to the farm has been found to be entirely satisfactory for shipping short distances — say fifty to one hundred miles, several such baskets now going empty and returning filled weekly through the Washington Post Office.

Housewives who want to deal with the farmers direct will realize that sometimes they may not be able to make an entirely satisfactory arrangement the first trial any more than they may find satisfactory the first city dealer they may try. Therefore, it may be found advisable to select from this list, at random, the names of three or four farmers to write to, and from the replies pick out two or three of the more promising, give them a trial, *and report results to the Housekeepers' Alliance.*

Remember that it is more economical to buy three or four dozen eggs by parcel post than one or two dozen, because after the first pound the postage will cost the farmer only 1 cent per pound. When writing to the farmer for his prices, it is well to tell him what the same articles are costing in the city market at the time. This is advisable because some farmers have an exaggerated idea as to the prices that city people are willing to pay for fresh country produce, whereas, others are entirely moderate and reasonable. It is also well to direct the farmers to mail the basket so that it will arrive in this city in time for delivery on the day desired. If intended for Sunday, it should reach Washington not later than Saturday noon.

TOO EARLY TO PROPHESY.

It is of course too early to make any definite prophecy regarding the outcome of this experimental attempt to bring consumer and producer more closely together. To my mind it is by far the most promising effort which has ever been inaugurated. There is a distinct advantage in having a powerful agent like the Postoffice Department of the United States come as a mediator between the two warring factions, namely, consumer and producer. This is a kind of mediation which gives promise of really helpful results. If the Postoffice Department is only patient and persistent, and if the consumer and farmer are earnest in their desire to be brought into closer contact, and each will do his utmost to make this contact agreeable and profitable, success cannot fail to crown the work. Already a business of considerable magnitude is doing, and it is growing every day.

One fact, however, must be kept in view. The transmission of very small articles, even by parcel post, is necessarily more expensive from the initial outlay than the transmission of large quantities of food products by freight trains. The initial charge of five cents per pound for the first pound in the package will always be a drawback to any complete system of economy where only pound packages are required. In other words I may express my view in this manner, namely, that the sending of a single pound by parcel post is not destined to be a commercial success.

But the outlook is quite different where a minimum, say, of five pounds is ordered by each consumer. The initial pound pays five cents in the first and second zones, and the subsequent pounds only a cent apiece. A five-pound package may, therefore, come to the consumer at a cost of transportation of nine cents, which is less than two cents a pound. In addition to this the package is delivered directly to the consumer, and thus the charge which the local market man and the local grocery man must always make for delivery is avoided. When this is taken into consideration, I think it may safely be said that the cost of delivery by parcel post is not very much more than that of the ordinary methods of commerce now in vogue, in the purchase and delivery of small packages from local stores. I am inclined to believe, therefore, that the cost of transportation of food products by parcel post is the least important factor of the problem.

The real difficulty is in the proper selection and packing of food products by the farmer in a way to please the consumer. It will, therefore, be necessary to have a campaign of education started among the farmers, in order to teach them these fundamental principles.

XV

BUSINESS METHODS IN FARMING

ONE of the most discouraging features of agriculture, both from the side of the practical farmer and from the point of view of the business man who wishes to engage in farming, is the complicated system of bookkeeping which every farm requires and which practically no farmer ever uses. An apt illustration is that of my own experience and that of my neighbors in the growing of beef cattle. In the neighborhood where my farm is located it is almost the universal custom of every farmer to grow a few beef cattle for the market. The region naturally comes to blue grass, which affords an opportunity of preparing the cattle for market at a minimum of actual expenditure for food. The farmer in my neighborhood usually buys his cattle in the autumn, gathered from the mountains of Southwestern Virginia or Eastern Tennessee, or sent from Chicago. These animals weigh from 600 to 900 pounds, and they are expected to be ready for the market within about ten months after their purchase in October or November of each year. These cattle are usually kept in the open over the winter, and fed unshredded corn fodder in the fields, together with a little Indian corn. They gain nothing during the winter, usually lose in weight, and are not particularly pleasing in their appearance when they begin to shed their long hair after the rigors of the season are over.

Along about the middle of April the grass is sufficiently grown so that they no longer have to be fed. They are ready, usually, for the market from the end of August to the first of October. Many farmers supplement the grass feeding by beginning to feed the immature Indian corn as soon as it is suitable for that purpose, which is about the middle of August. The corn is simply cut in the fields and scattered in the pastures for the cattle to eat. These cattle usually take on about 300 pounds in weight during the summer months, so that they weigh from 1,000 to 1,200 pounds at the time of sale. If the average cost is about $45 a head in the autumn, they bring from $70 to $90, say an average of $80 a head, when sold.

It is the universal custom for the farmers to reckon their profits on the actual difference between the purchase and selling price. For instance, it is not unusual to hear the farmers say that they made from $25 to $40 per head. In point of fact, if they should keep a record of the interest on their money, taxes, attention, cost of food and cost of pasture, the presumed profits would dwindle to a very small sum or actually disappear. In my own case, counting all of the expenses as above indicated, I lost from $5 to $7 per head on two successive years and made from $10 to $15 profit in the next succeeding years, due largely to an increase in the price of fat cattle. Something, of course, should be allowed for the value of the manure of cattle on pasture. As this is widely scattered in the urine and feces of the cattle, or collected under the trees where they chew their cuds, it can be dismissed as of but little importance. My observation shows me that the growing of beef cattle under such conditions as those mentioned above is rather an uncertain business in so far as real profit is concerned.

Perhaps there is no other business in this country in which so little is known of its financial condition as that of the ordinary farm. Often farmers may set down the sums they pay out and those they receive, but the number is not great. Bookkeeping is an exact science and the average farmer does not understand its first rudiments. He does not know how much it takes to keep a horse a year nor the value of the food which has prepared his hog for market. The household supplies, clothing, and luxuries are not reckoned in the year's balance sheets. He often does not know how much he owes, and can give little help to the assessor who makes a list of his possessions for taxation. The comparative cost of the various crops he grows is an uncut page in his book of knowledge. He only knows his father grew these crops and they have come down to him as a part of his heredity. In the public schools which he may have attended for a few years, bookkeeping was no part of his arithmetic. Yet what more interesting way of teaching arithmetic than by the practice of the simple principles of keeping accounts? Inasmuch as a large majority of our farmers do not go beyond the "common school," it would be the part of wisdom in our school authorities to make this study one of chief importance. It is useless to attempt to introduce on our farms the principles of efficiency, so long as we are ignorant of the fundamental data of the farm's expenses and receipts. I have already attested to the desirability of the payment of all bills by check. I assume that on the stub of each check is entered the purpose of the payment. In the case of bills at stores and elsewhere the receipted payment should be attached to the canceled check when it is received from the bank. The farmer in all cases when he wishes to look up a past transaction will find

JUST AT THAT TIME FARMERS WERE OFFERING FROM $1.50 TO $2.00 FOR HELP IN THE CORN HARVEST

I HAVE ALL I CAN EAT AND WEAR. WHY SHOULD I WANT MORE?

the most important data on record on the stub, the returned check and the payments he has made for labor and how much has gone to each man, what proportion of his outlay has gone for repairs, upkeep and improvements; in short, in the absence of any other record he will be able to get a fair summary of his financial standing from his check book. In addition to this he should always make out a duplicate of his deposit check, stating in each item its source and details of the payment. Thus both his income and outgo are at hand for comparison. But the home consumption, and the general cost of housing and keeping will, of course, fail of record in the check book. This fault might be avoided by a supplementary record of the amount of the home-grown food and other supplies used in the home. The farmer who keeps even such simple accounts as those outlined, gets a hold on his business, takes a greater pride therein, and ends by being prosperous and useful. I always feel like saying to a farmer who keeps this useful record, "You are on the road to prosperity, soon you will be out of debt and you will take an increasing pleasure and pride in your business."

In further detail I urge every farmer who reads these lines to make at least one experiment. If you have a field of which the area is known — do you know of any farmer who does n't *guess* at the size of his field? — keep just one accurate account of one crop. Suppose it is wheat. Compute for one year the following data:

A. Value of land per acre and interest at 6 per cent.

B. Taxes.

C. Fertilizer (commercial), amount used and cost, including hauling and drilling.

D. Loads and cost of manure at 50 cents per load.

E. Days of team and men, plowing, harrowing, rolling and planting at $4 per day for team and man.

F. Bushels and cost of seed.

G. Cost of planting.

H. Cost of harvesting.

I. Cost of hauling, thrashing and sacking.

J. Cost of delivery to market.

K. Value of wheat sold.

L. Profit — or loss.

The farmer will be surprised at the value of the knowledge which such an account will give him. He will be encouraged to apply this system to all his crops and for every year. He will learn where his losses are and how to stop them. He will know where his profits come from and how to increase them.

XVI

FARM FINANCE

THE farmer must not only be a scientific man and a skilled artisan, but he must also have some fundamental notions, and sound ones at that, concerning finance. It is extremely easy for the farmer to go into debt, especially if his farm is not mortgaged. The country store or the village merchant will give a farmer unlimited credit as long as his farm is unencumbered. But this question is a pertinent one, namely, Should the farmer go into debt?

This can be properly answered both affirmatively and negatively. The farmer is justified in going into debt when by so doing he can secure the necessary funds either for the payment for his farm or its equipment. A reasonable indebtedness, at a low rate of interest, is justifiable for expenditures of this kind. On the other hand, a farmer cannot go into debt with safety for the expenses of fine clothing, riding horses, carriages, automobiles, flying machines, and the unknown and untried schemes of every description with which he is beset.

I go even so far as to say that it is not justifiable for a farmer to go into debt for a melodeon or a piano or a pianola, and certainly not for unknown and unproved pieces of farm machinery, nor for books that are sold by instalment, nor for new kinds of lightning rods, nor for any kind of a bunco proposition of any description.

The farmer is too often regarded as an easy mark for the man who has bizarre things to sell. Before he knows it the farmer may have become deeply involved for articles which are of no practical value, which do nothing to increase his farming facilities, and which upon the whole may be regarded simply as waste materials. Debts incurred for such purposes as these are indeed a threat to the stability of the farmer's credit and prosperity.

In the purchase of land where the purchaser has not the funds for cash payment, it seems to me there is no distinction between giving the mortgage to the original owner or in giving it to somebody else and paying the original owner in cash. This is true only where the rates of interest in the two cases are the same. Land being the most stable of possessions, should be able to bear a debt at the lowest rates of interest. In point of fact, however, the rates of interest on money loaned on farms are usually higher than on money loaned on real estate securities in cities. Why this is so I cannot imagine, unless it be that many farmers are proverbially slow pay and it is not always possible to convert a farm mortgage into cash when the cash is badly wanted.

PAY ALL BILLS BY CHECK.

I have already mentioned that where it is possible to have access to a bank which is reliable, the farmer should keep his moneys on deposit and pay all his bills by check. Not only is the paying of all bills by check almost the simplest form of bookkeeping on the farm, as a simple entry on the stub will be a sufficient guide to review the character of the expenses, but the carrying of loose money about in the pockets, or keeping it about the house, has two distinctly unfavorable features. In the first place, if the money be carried on the person it may be easily lost. In the second place, if it is hoarded in the house it is an attractive mark for the burglar. Burglars do not "burgle" in the dark, at least not usually. If they are the right sort of burglars and know their business, they do not go after a prize unless they know its magnitude and the place where it is to be found. Hence it follows that if the farmer keeps no money about his house, in so far as that is concerned there is no attraction in that house for the thief. For convenience, for systematic keeping of the accounts, and for economy, it is well that the farmer's money be kept in the bank.

IS IT BENEFICIAL TO BE IN DEBT?

It often has been said that to be in debt is an incentive to greater exertion. Perhaps this may be true, but it is a kind of incentive that should not be necessary on the farm. The love of nature, the joy of outdoor life, the pleasure of producing something valuable, the duty of providing food and clothing for the family, and the science of taking care of the fields, ought to be sufficient inducement to any farmer without being driven by the sting of debt. It is true, in many cases of negligence and unthriftiness, that the farmer who receives money which should be applied upon a debt, will not pay it, but will start a little banking account of his own, put it in his pocket or spend it for some pleasure or amusement. This is a most unfortunate habit, however, and should not be encouraged.

The small farmer at the best does not have a very large capital invested. If his farm has cost him $7,500, his implements and live stock and other permanent investments will bring the sum up to probably $10,000, but not more. Ten thousand dollars loaned on gilt edge securities may bring an income of $500 a year. If the farmer so manipulates his agricultural work, with sufficient direction and industry, he may be well satisfied if he secures from the farm in which $10,000 is invested, an annual net money return of $500. I imagine that there are very few farmers, except in special cases, who get as large a return as this, even when not allowing anything for their own work.

The farmer's finance, then, is not on a large scale; but that is no reason why it should not be sound or why the farmer should not have fundamentally sound ideas of what investments mean and what interests and dividends indicate. For this reason the farmer should first investigate the condition of his neighborhood bank. He should know the character and standing of the officers and directors thereof, and whether or not it is engaged in any wild-catting schemes. If the bank is a private one, as these small banks often are, it may be very difficult to get the information which will give him what he wants to know on the above questions.

COOPERATION IN BORROWING.

The farmer can secure better terms for the money he borrows if he can coöperate with his neighbors. In doing this we see the foundations for coöperative rural credits. This system of furnishing money to the farmer is quite prominent in many European countries. A commission of wide-awake men, members of Congress and others, was sent to Europe in 1913 to study the system of rural credits there found. This committee brought back most valuable information, and the suggestions which it has made have become the basis of a bill which is now pending in the Congress of the

United States to establish a system of rural credits under national supervision.

A banking system which is inspected and approved by the officials of the United States would certainly be an improvement on the private banking system to which the farmer heretofore has had access. In a system of this kind all land of a community becomes pledged for the debts of the members of the union. Thus the security which is given is of the best quality, and the rates of interest thereon can be of the lowest. If first-class city property and securities can be pledged at a bank for 4½ or 5 per cent. interest, there is no reason why the associated securities of a rural community may not secure an equal benefit. Too often the rates charged farmers for borrowed money have been exorbitant. In many localities they have reached eight or even ten per cent. Only the most happy combination of events can render the borrowing of money by a farmer at this interest profitable.

THE LONG-TIME NOTE.

One of the principal points connected with a system of rural credits is the long-time note. In the city a merchant who needs money, usually with the aid of the name of another responsible citizen, may go to the bank and borrow money on call or for 30, 60 or 90 days, at a very low rate of interest. The bank soon receives this money again and it is kept in continual circulation. If the rural banks are to be established in the near future, under authority of Congress, and handle the funds of the community in a manner whereby it is possible to give long-time notes, it will be of immense benefit to the farmer. For instance, in the purchase of a farm by a man capable and industrious and honest, who expects to pay a large part of the purchase price from the proceeds of the farm, it is necessary that many years elapse before the whole of the purchase price can be realized from the products of the farm. Here is the ideal place for a long-time note at low interest. Such notes may run five or even ten years, if they do not represent too large a portion of the purchase price. A system of credits of this kind can also be properly coupled with a sinking fund, namely, that the farmer not only pays the interest annually or semi-annually, but also a small portion of the principal, thus gradually reducing his indebtedness and the amount of interest he has to pay.

POSSIBLE RATE OF INTEREST.

With a somewhat long experience in farm life, I am fully convinced that there are very few farms in this country so well conducted that they could successfully pay a rate of interest above 6 per cent., and with the very best farms for security that rate ought to be cut down to 5 or 4½ per cent. for long-time notes secured by mortgage on the land itself. Naturally a bank that had a lot of long-time paper would have to be most conservatively conducted. Its deposits subject to check would have to be strictly controlled, so that it would be possible at all times to secure the money for the payment of individual checks. Greater stability is secured in these cases by the depositor placing his money in the bank subject to order at a future date. In other words, a certain percentage of the farmer's deposits might be subject to immediate check, but any large portion of them should be subject to check only on notice of one, three or five months. Thus all danger of having a run upon the bank would be avoided and the officials would have ample time, in the case of having a large part of their deposits invested in long-term notes, to secure the amounts necessary to meet the time demands.

RURAL CREDITS.

The details of a system of rural credits can be worked out in this country only after a few years of experience with banks in actual operation. It would be impossible for any financier, no matter how keen his insight might be, to foresee all the problems which will come in connection with supervised rural banks. The problem, however, is not one that is insolvable. Naturally supervision of the expenditures of the money secured from the banks on long-time rural credit notes must be in the hands of the banks themselves. From each one who borrows a written statement of the purposes to which the money is to be devoted should be secured, and the bank officials should see that the money is expended strictly in harmony with the purposes for which it was borrowed. Otherwise it might be possible for borrowers from the bank to keep it in continual trouble.

This would be most easily done if the money secured on the loan were spent for the unnecessary or frivolous purposes which were mentioned above.

I do not believe that farmers should be encouraged to go into debt. The best farmer is the one who owes nothing and still has money in the bank. But I do believe that for the purchase and proper equipment of the farm in all the respects which I have mentioned it is advisable, permissible and necessary, for the farmer to go into debt. Debts of this kind, however, will be like debts of honor, and there is little possibility of loss to rural banks which extend all the courtesies possible to the farming communities in their neighborhoods, and for as long a time as may be necessary to work out the returns and repay loans.

PROPOSED LEGISLATION RESPECTING FARM CREDITS.

Extensive studies have been made of the systems of farm credits in vogue in European countries, especially in Germany. The commission authorized by Congress to make these studies was composed of two United States Senators, one member of the House of Representatives, and three citizens, the personnel being Senator Duncan U. Fletcher, Chairman, Representative Ralph W. Moss, Vice Chairman, Senator Thomas P. Gore, Mr. Harvie Jordan, Mr. John Lee Coulter, Secretary, Mr. Kenyon L. Butterfield, President of the Massachusetts Agricultural College, and Mr. Clarence J. Owens, Secretary of the Southern Commercial Congress. A full report was made by this commission to the Congress of the United States, and published as Senate Document No. 380, 63d Congress, 2d Session.

In considering the whole question of rural credits for the benefit of agriculture, the commission made the following statement:

> In considering this question the commission has attempted to define, in the first place, the needs of the American farming population in a financial sense. As noted above, a careful consideration of this point has resulted in its defining these needs as being two in number, as follows:
>
> First. The farmer's capital requirements, by which is meant the need of the farmer for large sums of money to be used in aiding to pay the purchase price of the farm, in improving his farm, such as erecting new farm buildings, draining, irrigating or clearing, or in equipping the farm so as to bring his operations to the highest state of efficiency.
>
> The money needed for these purposes must be in the shape of

a more or less permanent investment, or in the shape of loans extending over such a long period of time that they can be gradually reduced and paid off out of the increased earnings derived from the improvements made or the equipment added by the farmer with the proceeds of such loans. This is generally referred to as long-term or land-mortgage credit.

Second. The farmer's temporary or annually recurring requirements, by which is meant the money needed by him to finance his operations during the time that the crops are being produced. These temporary requirements recur every year and embrace the financial needs of the farmer for the purpose of preparing the land, sowing and cultivating the crops, and harvesting the same. This is generally referred to as personal or short-term credit. But the short-term credit of the farmer should be distinguished from the short-term credit of the merchant or manufacturer. The merchant requires banking accommodation for 30, 60 or 90 days, during which period he can dispose of the stock acquired and repay the loan; in contrast, the farmer may require short-term credit extending from the time the crops are planted until they are harvested, and this may be fixed approximately at from 90 days to 1 year. After the crops are harvested and stored in a barn, elevator, or warehouse, the need of agricultural banking is largely removed, as the financial handling of the crops so stored then comes under the province of commercial banking.

The questions, therefore, to be considered resolve themselves into the methods of furnishing for the farmer long-term, or land-mortgage, credit and short-term, or personal, credit. For convenience in discussing these two systems of credit, long-term, or land-mortgage, credit will be hereafter referred to as mortgage credit, because such credit must necessarily be based on the security of the land owned by the farmer and because such mortgage credit must for convenience be again subdivided into long term mortgage credit and short-term mortgage credit, as will be hereinafter shown. Short-term credit, or personal credit, as above defined, will be hereinafter referred to as personal credit.

In the opinion of this commission these two general classes of credit must be largely segregated, although the two systems will naturally touch at many points. Further, in the judgment of this commission, the development of a system of farm land banks is the most important and the primary step to be taken in order to improve our agricultural-credit conditions. It naturally and necessarily precedes the development of personal credit. This history of European systems has shown that the land-mortgage banks preceded the personal-credit banks. In this country it is urgently necessary to create a land-mortgage security which will be entirely liquid by reason of having a ready market, which will run for a long time, which can be paid off in small annual or semiannual instalments, and which will enable the land-owning farmer to use most advantageously his best banking asset, land, as the basis of credit.

In this part of the report the problems of mortgage credit will be first considered, since definite recommendations have already been carefully prepared suggesting important national legislation. The problems of personal credit will follow in a separate section of the report to be submitted at an early date.

In discussing the bearing of the experience of the European countries upon this question, special reference may be made to Germany as an illustration, since both systems of credit have attained very great efficiency in that Empire and remarkable results to the farmer have been secured, doubtless to a large extent as a result of the growth of agricultural credit. If space permitted, this comparison could be extended to other countries which were visited by the commission to good advantage, but probably additional and extended comparisons would make this report too voluminous.

In considering the conditions in Germany, as applying to the conditions in the United States, the essential points of difference between the two countries should always be borne in mind. In size the German Empire is about equal to the area of the State of Texas after cutting off from Texas an area as large as the State of Alabama. In population the German Empire contains about 68,000,000 people, or more than two-thirds of the population of the whole United States. In intensive farming the Germans are far ahead of our own farming population, and the average production in Germany has increased greatly, while our average yield per acre has increased but slowly. In Germany the population in a given district is largely homogeneous, and the individual is, so to speak, attached to the soil, the same farms continuing in the same families for generations. In this country such a condition is seldom found.

In Germany, on account of the limited supply of land and the large population, and on account of the known productivity of each piece of land, the value of that land is easily ascertained and varies within very slight limits. In this country the variations in value are very great. In Germany the average farm is about 20 acres; in this country the average farm is 138 acres. In Germany the credit and resources of the individual in a community are known to practically every other individual in that community; in this country no such accurate information is obtainable. In Germany the small farmer, his wife, and children all do manual work on the farm, in this country such a condition is rare. In Germany the people have been trained to a supervision and control of their operation by strict government regulations, which would not be favored in this country.

LONG-TIME MORTGAGE.

In every system of rural credits a special emphasis must be laid upon the long-time mortgage or long-time credit as distinguished from short-term or short mortgages, which are usually the securities in ordinary municipal banking. This system of mortgage credit the commission found has existed in Europe since the reign of Frederick the Great, and has been especially developed in Germany, and in the German states in Prussia. The fundamental principle of land-mortgage bonds in vogue in these localities is the issue of bonds which are based on the total value or security of many pieces of real estate, instead of on individual holdings.

This principle may well be illustrated as follows: At the present time, if four farmers living on adjoining farms desire to secure mortgages for any purpose whatever on their land, each one acts independently of all the others. In the collective system above referred to the mortgage would be laid upon the whole of this property for the benefit of the residents thereon, on terms agreed upon by these residents. It is easy to see that an extensive mortgage of this kind would be regarded as a better security than an individual mortgage, and it is for this reason that the rate of interest of the mortgage might be considerably lower. This form of mortgage is indeed an agricultural coöperation, and is a very primitive form of association among farmers which they can all easily understand and readily take part in.

LONG-TIME LOANS.

In general it is found that all loans that exceed five years in term are classified as long-term loans. The principal of these loans is not made repayable all at once, but in small annual or semi-annual payments. This latter method of re-payment is generally known as amortization. The issue of land mortgage bonds of this kind, connected with this method of amortization payments, is the distinctive feature of European long-term mortgage credit. In the opinion of the commission this feature should be incorporated in any system of rural credits authorized by Congress for the general benefit of agricultural borrowers of the country. Naturally under this system the duration of the loan is determined by the rate of partial payments on the amortization scheme. The commission gives the following example:

If 4 per cent. bonds are selling at par and the bank charges thirty-five one-hundredths of 1 per cent. for administration, then an amortization rate of fifty one-hundredths of 1 per cent. will extinguish the debt in 54½ years; that is to say, the borrower will pay the bank a rate of 4.85 per cent. on the sum borrowed for 54½ years. The bank divides this payment into three parts; 4 per cent. goes to pay the interest due on the collateral trust bond which the bank issued to secure the money which was loaned to the farmer; fifty one-hundredths of 1 per cent. is applied toward the payment of the principal, and the bank receives thirty-five one-hundredths of 1 per cent for expenses and profits. If the bond sells below par, either the farmer must pay a commission to the bank or the discount must be met by the bank from its administration fund; on the other hand, if the bonds sell above par, the premium may go to the borrower or to the institution in the form of profit. Generally speaking, the interest rate to the borrower is determined by the market value of the bank's collateral trust bonds, generally referred to as land-mortgage bonds, the rate to the borrower rising as the bond falls below par, and lowering as it advances above par.

If the rate for amortization is higher than fifty one-hundredths of 1 per cent., the loan will necessarily be extinguished in a shorter period than 54½ years.

A limitation as to time is usually fixed by law as well as to the rate which the bank may charge for administration. In actual operation in Europe the time limitation varies in general from 30 to 60 years, and the charge for administration varies from fifteen one-hundredths of 1 per cent. in a purely mutual association of borrowers to thirty-five one-hundredths of 1 per cent. in joint-stock banks. The French law allows a margin of sixty one-hundredths of 1 per cent., as does the recent Spanish law. This charge is computed on the principal sum remaining unpaid, and in long-time loans it is therefore a constantly decreasing charge to the borrower.

These rates of payment for interest, amortization, and administration are definitely fixed in the terms of the mortgage and can not be changed by the bank. The borrower, however, is always given the right to discharge his obligations at any interest period after a fixed time. This period is commonly designated in Europe as 10 years. This right is a double protection to the borrower. First, it protects the debtor against any demand for payment of his entire debt or an increase in the annual interest charges; second, the provision for repayment at pleasure gives the borrower complete protection against a general fall in interest rates. This will be a very important feature to American debtors, since the tendency in the United States will be toward lower interest rates for farmers. Under such a contract a borrower could safely assume a liability maturing regularly over a long period of time, because if interest rates were to fall he could borrow money elsewhere at the lower rate of interest, discharge his obligation, and thus secure the advantages of a cheaper rate on money.

RURAL CREDITS FREE FROM TAXATION.

The commission further points out that in order to make these long-time bonds as cheap to the farmer as possible, it is of prime significance to make them free of taxation. I have long been of the opinion that the system of double taxation which is so largely practised in this country is fundamentally, morally and ethically wrong. For instance, if a farmer borrows money on a mortgage, he has to continue to pay his tax on the land which secures the mortgage. At the same time the person who holds the mortgage is taxed upon the mortgage itself, which is naturally another tax upon the land, as the rate of interest must be high enough to pay the man who loans the money a reasonable interest and also to enable him to pay the tax upon his holdings.

The commission therefore strongly urges that these long-time mortgages at low rates be specifically exempted from taxation both by state and national authorities. They quote President Taft to the effect that farmers are paying higher interest rates than any other class of business men, and refer to the fact that in the Middle West, where land values range from $100 upward per acre, if the land be mortgaged for 50 per cent. of its value, and if the mortgage is taxed, the debtor owner is investing $50 per acre and paying interest on $50 per acre. He is also paying directly the tax on the land and paying indirectly the tax on the mortgage, which is essentially what I have pointed out above. The commission, continuing, says:

Under these conditions — rising land values and cumulative taxation — the land is slowly but surely passing away from resident ownership to landlord ownership. Farm tenancy is undeniably on the increase.

Attention is called to the fact that without some modification of our present laws of taxation, the substitution of the European system of land mortgage will materially increase the possibilities of taxing fictitious values. The lender creditor does not receive the obligation of the borrower debtor, who issues his obligation, namely, the mortgage to a bank, and this bank in turn issues a second obligation, the collateral trust bond or land-mortgage bond, to the real creditor, the man who invests his money. If all these values are taxed, the land, the mortgage, and the bond, we will have increased the burden of taxation, which, under present conditions, rests so heavily on the owners of mortgaged real estate.

DIFFICULTIES BY REASON OF STATE SOVEREIGNTY.

The commission also calls attention to a difficulty which will arise in the institution of a system of long-term mortgages of an agricultural character in this country by reason of our double sovereignty. Not only are taxes laid by the nation in this country under various forms, such as customs and internal revenue taxes, taxes on manufactured products and incomes, but also we have a system of wholly independent taxation in the States, based on the theory of the absolute sovereignty of the State. The State, however, delegates its authority largely to the counties, so that special taxes for special purposes may be laid in the counties for school, road and other purposes, to be levied and spent within the county. This multiple system of taxation by independent sovereignties will of course require a special form of guaranty of land titles to secure the lender of the money from any possible loss.

It is therefore important, in order to secure these long-term mortgages at the lowest rate of interest, that the various States should undertake some form of guaranty of the title, so that the borrower may have no doubt whatever respecting the legality of the title on which his money is placed. If it is the purpose of the national and state governments to promote agricultural credits, then it is proper for them to do so in every reasonable way, and the guaranty of the title would remove one of the objections which so many people have to lending money on real estate.

It is recognized, by reason of this multiple form of government, that in any system of rural credits which may be proposed by Congress the sovereignty of the State must receive direct recognition, and that in no case would any set of banks in any one State be permitted to operate in the lending of money on collateral or other mortgages in other States. There would therefore be as many separate units of rural credits as there are separate States. In the large States it is also advisable that the areas of operation of the rural banks should be still further restricted. In other words, in the large States two or more areas can be fixed by the legislature to which the rural bank system of credits is confined. The more densely populated a community is, and the more restricted its area, the more workable will be the system of long-time rural mortgages. For this reason the area of the State will be the largest possible unit which could be made available for the protection of a general mortgage note. This plan of rural credits promises a lower rate of interest on farm loans.

STABILITY OF THE SYSTEM.

If a system of mortgage rural banks be established, and an act of Congress, supplemented by an act of the state legislatures, strictly limits the field of its operations, there should be no possibility under such establishments of wrecking the bank or of its going into the hands of a receiver.

The resources should also bear a definite ratio to the liabilities, and by a large percentage thereof, and the method of checking, by reason of state and national examiners, should be such as to detect any weak spots and strengthen them before they have become dangerous to the system.

The commission also calls attention to the fact that it is not necessary that the capital and surplus of the mortgage bank should be entirely invested in these long-time mortgages, but they may be invested in other shorter term securities. The resources of the bank may be, under proper restrictions, safely advanced from time to time in short-term loans at a higher rate of interest. The issue of collateral trust bonds secured by large areas of mortgaged territory is a slow process. Pending the completion of such issues, there could be no objection to the investment of the resources of the bank in shorter term notes properly secured. For this reason the land-mortgage bond, based upon the land-mortgage security itself, which can be sold in the open market and thus converted into liquid currency, is an important feature of the operation of banks of this kind. A certain proportion of the capital of these banks, under proper restrictions, should be reserved for just such purposes. In other words, the long-time mortgages themselves may be converted into temporary currency by means of the sale of the land-mortgage bonds.

TYPE OF BANK.

The type of the institution which shall be the banking unit has also been the subject of careful investigation. In Europe the original corporation was simply a mutual association of farmers in which the borrowers assumed an unlimited mutual liability. A member of this association owning real estate could mortgage his lands and was given the amount of his mortgage in bonds, based on the collective value of all the lands of the members of the association. He would then sell these bonds to any customer he might be able to find individually, and thus convert his mortgage into money. The association of farmers simply issued bonds against the collective security, which was the whole of their lands, and delivered these bonds to the borrower in exchange for his mortgage. It did not necessarily give any assistance to the borrower in either selling the bonds or keeping their value up in the market after the sale.

Following this primitive system joint-stock banks were established, and these banks had particularly for their function to become a selling agency, to dispose of the bonds issued to the individual mortgagor to a better advantage than he possibly could by going into the market himself. Thus these joint-stock banks, secured as they were by the general mortgage on the lands of the whole association, were able to supply the individual borrower with the money which he wanted, and they stood, of course, in a position to repurchase these bonds whenever they saw fit, thus reducing their liabilities. The amount of bonds in proportion to the mortgaged

MOVING THE THRASHING OUTFIT

HAULING WATER FOR THE TRACTION ENGINE

capital was kept strictly within the limits of safety, and this would give a complete guaranty to the soundness of the issue.

The commission recommends as a bank best suited to the people of this country an institution with a foundation share capital limited to loans on agricultural real estate within a circumscribed area. The minimum capital should not be less than $10,000, with compulsory increase, either by accumulation of surplus funds or sale of capital stock in proportion to the increase in the volume of its business.

Also, in the judgment of the commission, any legislation providing for the establishment of land mortgage banks should authorize the establishment of co-operative as well as private joint-stock institutions. Any attempt to force all of our rural banking institutions into one rigid form would probably fail. In these coöperative or private stock banking institutions there should be no difference in the methods of doing business, the only difference being in the form of organization.

STATE AID TO RURAL CREDIT.

The question of state aid to rural banking systems is one of great significance. In this country there has been a persistent opposition to the aiding of any banking system by the nation or the State. Nevertheless, the country has been honeycombed with state banks, and in former years with most disastrous effects in some of the States. The State will have a greater interest in a banking system in which it has a financial interest than it can have in any other way. Therefore, as a means of security and conservatism of administration, it seems advisable that the nation or the States should extend some financial aid to the banking system.

In Europe the rural banks are often helped by the State. In Austria, in fact, the mortgage banks are strictly state or provincial institutions whose bonds are guaranteed by the State or province chartering the banks. In France, the State gives a subsidy of $2,000,000 to the Crédit Foncier, and also gives it a monopoly of the long-term mortgage business. The rest of the capital, however, of the Crédit Foncier has been raised by the sale of its stock, and in all of the essential principles of its administration it corresponds to the ordinary banking system of the United States, with the difference that certain special privileges are granted to the Crédit Foncier by the State in order to aid more readily these long-time investments.

The Commission finds that in every instance in Europe where government capital has been granted to establish mortgage credit, the results have been favorable to the agricultural interests of that nation, but it is their opinion that such aid should not be extended in the United States. With a farm property the value of which is computed at $40,000,000,000, and is rapidly increasing in value, the commission is of the opinion that this value is as stable as the foundations of our Government and is sufficient to attract capital in ample volume to improve and cultivate its area without subvention from our Treasury.

DIFFICULTIES ARISING FROM SPARSENESS OF POPULATION.

I, of course, do not like to inject any personal opinion against the consensus of so wise a body of men as that composing this rural commission. However, I call attention to the fact that our agricultural population is much more segregated than in Germany. It will be much more difficult to get them together and imbue them with a common purpose. The idea of pooling the total value of the land in a community would be most shocking to our rural centers. As a result, any legislation looking to the establishment of such a system of banks would take root but slowly. It is important, however, that some such system be speedily established for economic reasons to the farmer. In my opinion the establishment of this system would go on much more rapidly if at first some guaranty could be attached, either of the nation or of the States. When the system is fully understood by our people and its value appreciated, then State and national aid may be withdrawn without damage.

CONCLUSIONS OF THE COMMISSION.

Without going further into the discussion of the various details of the proposed banking system, I shall content myself with giving the conclusions of the commission in regard to this most interesting matter:

Day by day we are using the power of the whole people to do more cheaply or more efficiently some duty which had hitherto been performed by the individual. In agriculture we have been a pioneer people, actively engaged in taking possession of the surface of a great empire. Our farmers have been engaged in the hard labor of improving their farms, building school-houses and churches, and constructing bridges and roads for the public welfare. Science has but recently informed us that the fertility of our soils must be maintained and where depleted must be restored. We all know that our herds of meat-bearing animals must be increased.

While it may be said that these duties pertain particularly to the individual farmers, it can be answered in reply that farmers have not been able to accumulate sufficient free capital to meet the present situation. Our population has grown more rapidly than our agriculture has been able to expand on a scientific basis. It has been possible for our railroads and other highly organized industries to look forward to the future and estimate the rapidly growing demands of the public on their services. And yet, in many directions, we can see that our population has outrun the ability of our public-service corporations to serve them efficiently.

Agriculture has been the one great national industry which has been without organization and has been absolutely helpless before the wonderful growth of our Nation. Therefore, the financing of our farms has become a national problem. The savings of the Nation must flow out to the farms in order to put agriculture on a proper basis as compared with other organized industries. This can only be done by wise and patriotic legislation. Farm securities must be honored by Nation, by State, and by individual. Fortunately everybody will profit by such coöperation. The investor — from the smallest creditor to the largest capitalist — can purchase a security which has been thoroughly investigated by a bank under strict Government inspection, and which in addition is guaranteed by the capital of the bank. He has secured a bond which is practically as safe as a security can be. The owner of the property has been equally accommodated, since he can readily secure a loan on his property up to 50 per cent. of its value. The general public will be greatly benefited, because the cost of living will always be predicated upon the great law of supply of foodstuffs produced from the earth, and the volume consumed by the people who inhabit the earth.

There should be no hesitation, therefore, in enacting legislation which will give land-mortgage bonds — which are the basis of all true long-term rural credit — that favorable position which is always accorded State and Federal bonds, for both are based on the public wealth and are issued to strengthen and to perpetuate our Nation.

In closing this section of its report the commission desires to refer to the fact that the commercial world has had constructed for it a magnificent system of commercial banks; the frugal laborers and savers of the cities have their system of savings banks and building and loan associations, and the great corporations have their trust companies. All of these and other similar financial institutions assist in the financing of the agricultural industry to some extent, but none of them is adequate or can be made adequate to supply this special need without a sacrifice to their present field of endeavor. The commission recognizes that too great ease in borrowing should not be encouraged, since this might result in an unreasonable increase in farm debt. On the other hand, it should not be forgotten that under the present system tenancy continues to increase and farmers have outstanding obligations easily exceeding two billions of dollars secured by mortgages on their farms, much of which was negotiated under very unfavorable circumstances and with very high rates of interest. It is believed that under the plans which have been formulated herein, and which are intended to be supplementary to the existing system, tenancy may be decreased, the needs of farmers be taken care of, and at the same time the outstanding obligations may be refunded on much more favorable terms and gradually reduced by the regular payment of small annual instalments impossible under the general system now found in this country.

As carrying out the conclusions reached by this commission in its efforts to formulate a plan for the creation of land-mortgage banks, a form of bill has been drafted, which is attached to this report as a part thereof, and which is respectfully recommended to the consideration of Congress as an outline of legislation providing adequate facilities for meeting the needs of the farmers for long-term or land-mortgage credit.

As a result of its deliberations and of the hearings before the various committees, the Commission suggested a form of a bill to be considered by the Congress of the United States entitled

A bill to provide for the establishment, operation, and supervision of a national farm-land bank system in the United States of America, for the creation of depositaries for postal savings and other public funds, and for other purposes.

Various efforts have been made to secure the consideration of this bill at the present session of Congress. Other matters, however, of public interest, and especially the debates on the repeal of the free toll clause in the operation of the Panama Canal and the time spent in the discussion of more efficient methods of controlling trust operations, have convinced the leaders of the dominant party that there will be no time left for the consideration of this bill during the present session.

That such an act, however, as has been outlined above and the title of which is given, will become a law in the near future, there is little doubt. Inasmuch as the proposed legislation will probably be radically changed before it becomes a law, it would be a useless consumption of space to given even an outline of it. The commission has gone over the whole subject most carefully, and has tried to safeguard not only the interests of the farmers themselves, but also of the banking system as a whole, in the various provisions of the bill. One important Section is No. 18, which provides:

That every national farm-land bank incorporated under the terms of this act and the capital stock and surplus therein and the income derived therefrom and the mortgages and deeds of trust (and the notes and bonds secured thereby) held by said bank and the national land-bank bonds issued by the same shall be exempt from Federal, State, and local taxation, except in respect to taxes upon real estate.

RESTRICTION ON THE USE OF BORROWED MONEY.

Another important provision, which has already been referred to in the preceding discussion, is found as a part of Section 16. In this Section it is provided that:

Every national farm-land bank shall have the following specific powers:

To make loans upon farm lands anywhere within the State in which such national farm-land bank is operated: Provided,

(1) That such loans are made for not more than thirty-five years.

(2) That such loans are secured by a first mortgage or first deed of trust on farm lands.

(3) That such loans shall be made for any of the following purposes:

(a) To complete the purchase of the agricultural lands mortgaged.

(b) To improve and equip such lands for agricultural purposes.

(c) To pay and discharge debts secured by mortgages or deeds of trust on said lands.

(4) That such loans do not exceed fifty per centum in amount in the case of improved farm lands, and do not exceed forty per centum in amount in other cases, of the value of the said lands; to be determined by an appraisal, as provided in this act.

(5) That every such farm-land loan contain a mandatory provision for the amortization of such loan, or reduction of the same by annual or semi-annual payments on account of principal: Provided, That the loan extends over a period exceeding five years.

(6) That every such loan may be paid off in whole or in part by the borrower, in accordance with rules to be prescribed by the commissioner of farm-land banks, at any interest period, after such loan has continued for five years, by the payment of the whole or a part of such loan, with interest to such date, after crediting the amortization payments on the same as and when they were made.

In a final review of this most interesting subject I may say that, as a result of the investigations which have been made by the United States commission and the wise recommendations which they have made in regard to the matter, the whole system of rural credits in this country may soon be placed upon an entirely new basis. In this transformation not only will the farmer be able to get his money at a lower rate and for a longer time, but he will be supervised in the application of it for the specific purposes for which it was obtained. Meanwhile the borrower, on account of the increased value and stability of the security, will be perfectly content to let his money go at a lower rate of interest in the feeling of absolute certainty that there is no possibility of his ever losing any part of it. Both borrower and lender will thus be benefited, and agricultural prosperity will be promoted and increased.

A GIANT CHESTNUT, TWENTY-FOUR FEET IN CIRCUMFERENCE—THE LARGEST TREE IN LOUDOUN COUNTY

"The chestnut not only produces a large quantity of oil, but also a large quantity of starch"

THE FOREST

"In the forest he can stand with the trees and God as his auditors"

XVII

"BACK TO THE FARM!"

MY father told me (and I often heard him tell other boys in the country where I was brought up, for the purpose of inducing them to stay at home and not go to the city), the following story: "A farmer with three sons was asked what he purposed to make of them. He replied: 'John is the brightest of my boys, the most industrious, anxious to work, and quick to learn. I am going to make a farmer of him. Sam would rather talk than work, and is fond of telling all he knows and much that he imagines. I am going to make a lawyer of him. Thomas is the laziest one of all my boys. In fact, he is so lazy that he never gets into any trouble of any kind. I am going to make a preacher of him.'"

This story may be a little hard on the other professions, but it illustrates the contention which will some day be acknowledged by the whole country, namely, that farming requires the greatest industry, the keenest intellect, and the best training of all of the professions.

One of the most striking features of the last census is the record of decreasing population in agricultural centers and increasing population in the great cities. The tide of settlement which for many years had been flowing toward the unoccupied lands of the country has now turned, and is flowing toward the large cities. The result is of course easily foreseen. The number of consumers of food products is constantly growing greater, the number of producers smaller. This is not necessarily a cause for alarm. Fortunately there have been established in this country a number of agricultural colleges and experiment-stations in which the principles of scientific agriculture are taught. Methods of checking the depletion of the soil and of recovering exhausted fields have now been well developed and are practically enforced. Moreover, improvements in farm machinery have rendered the labor of the farmer more productive. I believe it may be said with a fair degree of accuracy that a day's skilled labor on the farm at the present time produces twice as much food as it did fifty years ago, and although the country districts have been to a certain extent depopulated and the cities overpopulated, the supply of the products of the soil in the way of food and clothing has more than kept pace with the increase in population. Yet the curious condition has arisen that while the consumer in the city pays a great deal more for what he eats and wears than he did a few decades ago, the farmer in the country gets little, if any, more for his products.

The result of this condition of affairs is that while in many respects the cost of living on the farm has been increased through the desire of the farmer to give a better education to his children and to be the possessor of more of the luxuries of life, he has not been securing a corresponding increase in his income. Moreover, the price of farm labor has greatly increased. In the old days a good hand would work on the farm by the year for twelve or thirteen dollars a month and his board. This, too, meant real work; for the farm-hand was expected to be up early in the morning, to help feed and care for the stock, and perhaps help with the milking; and with only short intermissions for meals, his work went on till dark, no matter how long the day. I am not an advocate for such long hours of labor; I am only stating conditions as they formerly existed. This was the condition of affairs that has led Abe Martin, the Hoosier philosopher, to say, "Twelve dollars a month an' no picture-shows makes Jack leave the farm." At the present time the laborer is not expected to begin work until seven o'clock, and he has an intermission of an hour at noon, and "knocks off" at six. At the same time he is not satisfied with seventy-five cents or a dollar a day, but must have a dollar and a quarter for ordinary labor, while at harvest and corn-gathering his wages rise to two dollars or more a day. Paying cash for labor is a burden to the farmer which is well-nigh intolerable; and yet if he does his own work, he must either have a very small farm or a very large family of boys and girls, who, moreover, are likely to leave him as they approach their majority. It is not strange, therefore, that the cry, "Back to the farm!" fails to appeal to the boy and the man in the city.

WHY THE BOY LEAVES THE FARM.

Why does the boy — not the lazy boy, but the boy of industrious habits — leave the farm in the first place? Because of his desire for a greater opportunity. He sees in the city a greater future for himself than he can possibly expect on the farm, and he will continue to go just as long as city life offers greater chances for success and a happier existence. Have we ever studied the psychology of the farmer's boy who has seriously considered his own future? These musings are doubtless very much alike. I remember my own mental attitude. I was born near the Ohio River, and could hear the whistle and see the smoke of the passing boats. When I lay under the wide-spreading beech-tree during my midday rest, I did not dream of a future on the farm. My thoughts followed the southward-moving steamboat down to the Mississippi, down past Memphis and Vicksburg, down to the cane-fields of Louisiana, to New Orleans and the gulf. My ambition was some day to get a passage on one of those boats and seek my career and my fortune in the South. Other boys on the farm have similar dreams.

What, then, are we to do to stop the flowing of the best blood of the farm to the city? The answer, it seems to me, is a simple one: make the farm a more productive place than the city, and its prospects for a career more certain. It is true that it is useless to hold up to the future farmer dreams of wealth such as that which is acquired on Wall Street, though it will be easy to show that Wall Street wealth is not the result of productive industry, but is the gleaning and reaping from the wealth of others. It is speculative wealth, a form of acquirement which will some day be forbidden by law. On the contrary, there can be held up to the intending farmer of the future a wealth of independence, of joy, and of productive industry which, joined with a fair monetary reward, should be, and probably will be, more alluring than the city life of to-day. It is useless to preach to the boy of the dangers of temptation. He is willing to take his chances, because his neighbor and playmate has gone to the city and is earning more money in some modest employment than he could ever dream of earning on the farm. A salary of even fifty dollars a month attracts him mightily, and when he thinks of the possibility of getting as much as a hundred dollars a month, it is a promise of opulence. In addition to this, he has the city lights, the city streets, the city amusements, and the stimulus of companions, all of which appeal to a boy, and all of which are natural desires.

MAKE FARM LIFE ATTRACTIVE.

The simple fact remains, however, that life in the country is the normal life. The man who does not touch the fresh-turned sod, make his way through the forest, follow the plow in the field, or gather the cattle at night, it seems to me, is missing the charm of existence. The glories of country life have hitherto existed only in song and story; but at present there are movements in various parts of the world to make it attractive. There are numerous magazines and newspapers devoted to rural life, and not only papers which teach practical agriculture, the care of registered stock, the growing of fowls, etc., but newspapers and periodicals devoted to the pleasures of the country and the inspiration of country life. Communities are forming, with clubs and associations, which offer to the persons living in the country many of the advantages of life in the city. Country life is becoming less isolated and more communal. People are beginning to understand that it is not well to build the house and the barn in the middle of a large farm, but rather on the corner adjoining a neighbor's house and barn. In fact, every four farmers might form a little community of themselves by building their farm-houses in adjoining corners. In this way, even if the weather were stormy, there could be society in the evening, and the neighbors could come together and discuss affairs of common interest.

The church and the school-house are also becoming places of social enjoyment. In one or two places clubs have been formed and houses erected where the farmers can gather as they do in a city club, and these are equipped with a library, a gymnasium, billiard-tables, and a swimming-pool. One of the curses of country life is muddy and impassable roads. Good roads are now being built throughout the country, and these will do much toward making country life attractive, because they mean ease of access and more intimate association, as well as economic advantages.

The electric trolley is carrying the city into the country, and making it possible for those who have business in the city to live in the country and have a little farm or garden of their own. The wise managers of great factories are now going into the country and building their factories in the midst of estates. One of the largest factories in Massachusetts has grown up where every employee has an acre or more of land on which vegetables and other foods are grown. They have an agricultural fair every year which rivals the county fair in the wealth of its exhibits, all of which are grown by the employees. This is indeed bringing the city into the country. Another Massachusetts corporation with many thousand employees makes the following statement in its recent circular:

> Instead of setting the factory in the midst of a thickly populated community, the Company chose a spot near the seashore, in a beautiful rolling country, where in a tract of three hundred acres there would be ample opportunity for the development of advanced ideas. Among other things the officials felt that as far as possible the employees should own their homes and from the beginning they have stood ready to facilitate this object so far as they were able without going into the real estate business, or making heads of families feel that the re-

tention of their homes may be affected in any way by their continuance in the Company's employ.

No one can doubt the stimulating effect of such a community upon all the farms and all the farmers in its vicinity.

Every such settlement of the country not only benefits the laborers and employees of the factory, but also stimulates and encourages the enterprising farmer. When man in his wisdom has spread over the surface of the land somewhat more evenly than at the present time, there will no longer be isolated spots, producing melancholia and even insanity in their lonely inhabitants. The city is not a place of production, but only of exchange, and the wise city of the future will not invite factories of a productive nature, but will exclude them. Unfortunately the great rivalry between cities to-day is not so much for the welfare of their individual citizens, the education of their people, wise and economic nutrition, libraries and museums, but simply for population. The classification of cities for legal and other purposes is made solely on the basis of their total population. Thus by act of the legislature we have cities of the first class and cities of the second class in which the division is made on the basis of the number of inhabitants. The keen rivalry among cities to lead in the number of their population is well known. One may cite, for instance, the competition between Minneapolis and St. Paul, between Philadelphia and Chicago, and just now between St. Louis and Boston. Even New York aspires in the near future to rival London not in the kind and character of its people, but in numbers alone. So far as can be seen, this sort of rivalry is destined long to continue. Even in the capital of the country a movement is on foot to encourage the establishment of factories, hoping thus to attract a greater number of people! Washington at least should be the one city where the productive factory is unknown.

As I have said in another chapter, the house of the farmer is now being improved in such a way as to make him as comfortable as if he lived in the city. The conveniences of bath and lavatory are now being installed in many farm-houses, and the sewage therefrom is handled in a scientific manner, thus improving sanitary conditions and making life more comfortable and disease less imminent.

I am now building on my farm a double tenement house for the hands I hire by the year and their families. So far as I know these houses for the hands are the only ones in the neighborhood in which are found hot and cold water, bathrooms and water closets. The materials and workmanship of the house are of the best. Perhaps other farmers may see the humanity and sanitation of a septic tank.

MAKE FARMING PROFITABLE.

All of this, however, is not sufficient to keep people in the country. The pursuit of agriculture must become more profitable if the country is to reach its full fruition. Scientific agriculture will help, but to bring the consumer and the farmer into more intimate contact is most important of all. This will surely be accomplished by establishing factories in rural districts, where farmers can sell direct to the employees of the works. At the present prices for commodities which the farmer must buy, he cannot expect to be financially successful with wheat at a dollar a bushel and fat beeves at seven dollars a hundred pounds.

Let me repeat what I have said elsewhere in this book and give a bill of particulars. I am a fairly good farmer, born and bred on a farm, and I direct (unfortunately *in absentia* most of the time) a reasonably good farm. My tenant sold wheat of the crop of last summer as low as eighty-four cents a bushel within one hundred miles of Baltimore, which is a great wheat market. The cost of transportation to Baltimore is a little over six cents a bushel, so that the price in Baltimore at the time was ninety cents. This wheat was grown on land fertilized with so-called commercial fertilizer, and a careful record of all the expenditures, with all reasonable charges against the land, interest on the investment, taxes, etc., left only a very small profit.

Again, I bought stock cattle the last of November, 1910, at $46.50 a head. I kept them for about a year, and sold them for $61.00 a head. If I allow only five cents a day for the feed and care of these animals, I come out of the transaction with a loss of more than three dollars a head. These fat cattle weighed almost exactly 1200 pounds, and were sold at the railway station three miles from the farm at the rate of $5.30 per hundredweight. If I, after long experience of practical farming and long study of scientific farming, am scarcely able, or not able, to make farming pay one hundred miles from Baltimore and only sixty miles from Washington, are others likely to succeed better? Yes, I may answer, if those others spend their days upon the farm, take part in its labors, and personally direct all of its affairs.

These are not theoretical conjectures, but figures from actual experience. A like bill of particulars could be given for every article grown on the farm, where labor is all paid for and a correct account kept of all just charges. The reason the farmer thinks he is making money when he is doing work like this is because he pays himself nothing, does not charge himself rent, takes no account of interest on the land or of the expenses of its maintenance. He thinks he is making twenty dollars on every steer that he fattens and sells, or fifty cents on every bushel of wheat he grows, when in point of fact he is probably running in debt on both counts.

THE MIDDLEMAN USEFUL.

I am not in sympathy with the theory that the middleman is unnecessary. I do not see how I, as a farmer in Loudoun County, Virginia, can take my products to New York and sell them direct to the consumer. I do not believe that the railways of the country are eating up the farmers' profits. In this country, under the present method of distribution, the railway is the salvation of agriculture. Without the railway, the cost of bringing food commodities to the great cities would be immensely increased, and the price paid to the farmer would correspondingly diminish, while the price paid by the consumer would correspondingly increase. Moreover, trade in food products could not be carried on without the wholesaler and the retailer. They are, like the railway, necessary to distribution. But in farming as in logic we do not want too much undistributed middle.

The true problem to be solved is the regulation of these avenues of transportation and methods of distribution, not their suppression. It might be well to ask, though, if there are not too many railways, too many brokers and wholesale and retail merchants. In other words, one of the principal problems relating to country life is undoubtedly that which is connected with the transportation and distribution of agricultural products. Extreme difficulty will attend the solution of this problem. The trades, as they are now established, are very jealous of any control or restrictive legislation. A mere suggestion that there might be some economic interest between producer and consumer is met with a chorus of protests from interested parties. Petitions have already been laid before the President of the United States, asking him to muzzle any public official who indicates that there may be a necessity of reform in this direction.

THE SPIRIT OF COMMERCIALISM.

It is astonishing how short-sighted some people are in economic matters. Let me give an instance. In Washington the school authorities have authorized the establishment of a lunch-counter in one of the public high schools where wholesome and hot lunches may be served at a few cents each. This is intended specially for the poorer pupils who cannot bring good lunches from home, but is also intended for those who are well-to-do, on the theory that the hot lunch is better than the cold one. In the Washington papers of December sixth, there is an account of a protest against this arrangement, which has been numerously signed by the business men of the neighborhood of the school, because it interferes with the profits of the grocers and restaurants in the vicinity!

It is this spirit of selfish commercialism which seems to me to stand in the way of a betterment of conditions. I do not claim that the farmer is not actuated by just as keen a selfishness. As a rule, the farmer, I think, would not hesitate to get a higher price, even if the ultimate consumer had to pay more. But the problem is not of this character; it is predicated on two indisputable facts: first, that the farmer is at present getting too little for what he produces, and, second, that the consumer is paying too much for what he consumes. Somebody or something in between must be eliminated; not the system, but some of its members or practices.

A practice has grown up in the army, and is probably legalized, whereby the families of officers are permitted to secure from the government stores their food, clothing, and coal. In talking recently with the wife of an army-officer I found that the prices paid by her for these necessities of life are very much lower than those paid by citizens to the merchants of the town. Naturally the trade objects to this distribution of the necessities of life to the families of officers, but it goes on. Objection may be made to this that it is not good business. It may be thought that the supplies furnished to officers' families at the cheap rate mentioned are really paid for by the taxpayers of the country. Of course it is true that the food of the army is thus paid for; but the supplies which are furnished to the officers' families are furnished at cost, and do not impose any burden of any kind on the taxpayers. The army is compelled to have its commissaries and its quartermasters with their clerks, storehouses, etc., and the distribution of supplies to the families of officers is thus made without additional cost to the Government.

Mayor Shank of Indianapolis, acting without authority of law and spending not a penny of the citizens' money, has sold some of the necessities of life in the open market of that city at a price considerably below that charged in the public markets. He made a specialty of potatoes and turkeys for Thanksgiving, and sold directly to the people of the city in this crude way at a greatly reduced cost. Of course no profit was made on this transaction, but the consumer was brought nearer to the producer. To this, objection may be made that Mayor Shank's action is not "good business." No, it is true it is not business in the ordinary sense of the word; that is, Mayor Shank did not go into this venture for the sake of making money. May not this experiment, however, show what might well be accomplished by governmental control of socialistic activities? The recent report of the Postmaster-General shows that the calendar year has closed with profit, and that all the money which the Government expended in carrying the mail has been refunded by those who pay for stamps. This, perhaps, is not "business," but is there any one who wishes to take the post-office department out of the hands of the Government and to put it into competitive trade?

May I suggest that although this is rank socialism, it may be the one solution of the problem. The State now carries our letters and newspapers, and I doubt if any combination of men who would desire to secure control of this transportation could influence the people of the country to take this away from the State and give it back to competitive business. Can any valid reason be presented in opposition to the State's taking charge of the telephone, the telegraph, and the express companies in the same manner? If this is considered to be a legitimate function of the State, has not Mayor Shank shown a way to cheapen existence?

I said that I did not see how any fair argument could be presented against such a scheme. On further reflection, I find that there is one. Control by the State naturally would occupy the services of only a portion of those who are now engaged in business of this kind. There would therefore be a considerable number of people, now engaged in the competitive distribution of food products, who would be left without employment and driven to seek other means of living. This might be hard on other over-crowded occupations. But there is one occupation which is not over-crowded, that of skilful labor for the fields. It is not so much the high price which the farmer has to pay for his labor as it is the difficulty of getting any at all. In wheat-harvest and corn-harvest it is almost impossible to get men to work on the farm, and those who are available are men who are not skilled and whose services, even at much more moderate prices, would be expensive.

RETARDING EFFECT OF LOW WAGES.

But the question may be asked, How can you expect people to go back to the farm while farm wages are so low? A man would prefer to remain in the city in trade which does pay. The question is, Do these trades really pay? Is the man who works in the city for two dollars and a half a day as well off at the end of the year as the man who works on the farm for eighteen dollars a month and his board, or for even less with his board and lodging? In my opinion the man who works on the farm and has his board and lodging provided, as a great many farm-laborers do, even at the small wage of fifty or sixty cents a day, is better off at the end of the year, and his children have been better fed, than the man who works in the city for two dollars and a half a day. The difference lies in the social advantages and the educational facilities which the city man has, and not in the amount of money which he puts into the savings-bank. If we could provide the laborer in the country with the same social and educational life which we provide the laborer in the city, at the end of the year the country man would be distinctly ahead. If the movement to bring the city back to the country succeeds, an opening, it seems to me, would be made for the employment of those who might be left without an occupation if "nationalism," rather than "socialism," were extended to the distribution of the necessities of life.

There may be other and better ways of correcting the evils which undoubtedly exist. The above is only a suggestion of ways that have already been tried, and with success. When people come back from the city to the farm, as I picture the farm in the future, it will not be to lead a life of dreary labor, but rather to engage in an occupation which will command intelligence and the best business capacity. The problems of biology, for instance, which farm life presents are of undying interest.

When the city comes back to the country, it will come with culture, with intelligence, and with knowledge. The science and art of agriculture, drafting into its service, as it is doing at the present time, every other science, will so increase productivity that no Malthus nor Sir William Crookes will ever rise again and prophesy starvation for humanity. While the needs of the human mouth remain constant, the skill of human hands, and their ability to produce, are becoming greater and greater. As a rule there are two hands to each mouth, and these hands in the far future, as far as philosophy dares look, will be able to supply the wants of the mouth.

XVIII

POWER ON THE FARM

MANY years ago, in an interview with Mr. Réne Bache, I suggested the possibility of the farmer availing himself of the wind as a convenient source of energy for various purposes, including lighting, heating, and the driving of small farm machinery. This interview was published by Mr. Bache, copied in a great many newspapers, and evidently created a great interest in the matter. Beyond, however, an academic interest, very little was done towards putting this idea into execution. I believe that it was first in England that it was put into practical effect, and within a year or two a few wind-mills have been erected in this country with the same purpose in view.

The idea is a simple one, namely, that as wind is one of the most widely distributed sources of power, any method by means of which it can be harnessed and made uniformly available must of necessity offer to the farmer some advantage over any other form of power which can be utilized, whether of steam, gasoline, or of an animal source. The necessary conditions for success, as I set forth in my original paper, were the proper construction of a wind-mill of sufficient capacity to develop two or three horse-power of electricity, combined with a cheap and inexpensive storage battery capable of storing the power during the periods of windy weather, so that it could be utilized in periods of calm. It is evident that any system of lighting about the farm or barn, or of cooking or heating, which would be useless when the wind was not blowing, would not be of practical application.

AMOUNT OF ENERGY AVAILABLE.

A moment's consideration of the problems involved will show that they are not insolvable. In the first place, the amount of energy which is exerted by the moving currents of air is so great as to be almost immeasurable. If only a small fragment of the total energy of moving air could be utilized, it would supplant every other known source of power. When you consider that a wind-mill of only eighteen feet in diameter will drive a dynamo of very considerable size, and in addition to furnishing the working requirement store up any desired quantity of force in a storage battery, you can readily appreciate the enormous energy of the moving air currents. Particularly appealing to the man of some means who desires to go on a farm is this idea of harnessing the power of the air. It is simple, clean, inexpensive, requires little attention or regulation, and is utilizable in many different ways.

There is no source of energy so mobile as electricity. Now that the scientific world has come to the conclusion that electricity is the fundamental constituent of the atom, it lies at the very basis of all power and energy. The electric force is easily applied to transportation, the driving of machinery, to the production of heat, and to the production of light. Thus it has the elements of universal application. The perfection of the electric engine and storage battery has made possible the driving of carriages and even of carriers of freight, the electric railway trains, both in the city and on standard lines, and the general adaptation of the electric force to all forms of power development. It is therefore the ideal source of power to which the farmer would turn for the varied needs of his farm and farmhouse.

It is true that the mechanical development of this idea is still in its infancy. Many failures are doubtless to be chronicled before it is perfected. Nevertheless, there are already on the market types of electric turbines which have been successful in operation and have given great satisfaction. The matter has already been taken up by at least one agricultural experiment station, namely, that of North Dakota, and a Bulletin, namely, No. 105, has been issued by this station on the subject of Wind-mill Electric Lighting and Power. Some of the points covered by this Bulletin are the following:

Since electrical energy can be made available to the farmer of average means for little or nothing, after the plant is once installed, the farm will become a place of social relaxation and will serve as a summer resort as well as a place of business. It will be possible to have an abundance of light throughout the house. Electricity can be made to do the pumping to supply water for the heating tank or for any other place; electric fans would lessen the extreme warmth of the summer, for there is nothing more comfortable for the men and women who have been toiling all day in the summer heat than the cool, refreshing breeze of an electric fan.

In the creamery, a motor could easily be arranged to run the cream separator, churn, butter worker and the milk tester. Electricity also could be used to pasteurize the milk, manufacture ice and freeze the ice cream.

Probably the housewife would next consider the laundry equipment the most important. There is no other source of energy so adapted to laundry work as is electricity. The drudgery of the wash-day is done away with when one is not compelled to turn a washing machine.

Electricity on the farm not only lessens the drudgery for poor old mother, but helps every individual and department. Think of the number of fires which occur every year, because some lantern happened to be tipped over in the barn. Too often lanterns are hung on unreliable nails in places where, if a horse should happen to upset one, the result would be the burning of the barn. There is but one solution of this problem; that is the use of electricity, and motors can be used in the barn for running the clipper, feed elevator or the milking machine. Electricity might still be used for various other important duties upon the farm, such as cleaning grain, in the shop for running the forge, drill press, emery wheel, grindstone, turning lathe, trip hammer, for electric welding, and for vulcanizing automobile tires.

DARIUS GREEN AND PROFESSOR LANGLEY.

At least one consideration should be kept in view, namely, that a source of power which is so universal and so inexhaustible as that of moving air currents, ought not to be neglected. The farmer now regards the air only as a carrier of moisture, and sometimes of storm and tornado. He looks upon moving air with some suspicion, because at the present time it causes him apparently more damage than good. But this is because the air has not been conquered. A few years ago the possibility of flying through the air was looked upon as a mere vision. "Darius Green and his flying machine" were held up for the amusement of the rising generation rather than its instruction. Even as late as the time of Professor Langley, the great scientist who seriously devoted himself to the problem of flying through the air, scientific and practical men looked upon it as a mere vagary of the imagination. Now the air has been conquered in so far as navigation is concerned. While the dangers are still imminent, the thing itself has been accomplished.

The true conquest of the air, however, is not by the balloon, nor the aeroplane; it is in harnessing the air to do the will of the people. When the mechanical difficulties have been surmounted, as human ingenuity can readily accomplish, and when the methods of manufacture have been so perfected as to bring the machines within the power of the ordinary well-to-do farmer, we may expect to see great changes and great benefits. Already steam and gasoline and coal oil are to some extent supplementing the ox, the horse and the mule as a means of farm labor, and especially of farm traction. When we view the victories which electricity has won as a moving agent in cities and on suburban lines of railway, and in the conquest of the roads by the motor car, we are not wise to place any limit to what it may accomplish on the farm. It is not a prophecy; it is only a statement of the thing which is certainly about to be, to look only a few years ahead and see the electric turbine a part of every farm equipment as much as a mowing machine and a gang plow are to-day.

In the *Electrical Review* of August 8, 1913, London, is an account of an electrical turbine system estab-

SPRAYING HOPS ON A LARGE SCALE

lished near Adelaide, Australia, which at that time had been in continuous operation for two years with complete success. The wind wheel in this installation is 18 feet in diameter, placed on a tower 60 feet high. The generator is of 2½ kilowatt capacity. The storage battery consists of 54 cells of 324 Amp. hour capacity at the 3 hour rate. The total number of lamps connected with this installation is over one hundred of varying candle power and the actual average output amounts to about 3 kilowatts per night. The plant is also used to operate three flat irons, one radiator, one electric motor driving a cream separator, some fans and for occasionally charging the battery of an electric motor car. The expense consisted of the use of about 30 gallons of distilled water every twelve months for keeping the battery full and the adjustment of the grease cups once per month. At the end of two years there was no sign whatever of wear or tear on the plant or the battery. The average wind velocity in the vicinity for the year was 8.8 miles per hour. In the operation of a corn planter a check wire is used which extends entirely across the field. It is not at all improbable that a movable wire which would convey electrical power to a plow or a mowing machine, could be similarly installed so that the current from the electric turbine, directly or through the large storage battery, might well be conveyed to one of the moving agricultural implements described.

It may seem somewhat visionary to prophesy the day when harvesting and plowing will be accomplished by the force of the wind; but it is not a visionary idea, it is entirely within the realm of possibility. The farmer at least should have no fear of the increasing scarcity of wood and the increasing cost of coal. He need not even depend upon the water power, which, in the dry season of the summer, often fails. The wind is always with him, and is an inexhaustible source of the energy to drive the machines of his farm, and to heat and light his house.

In this country a beginning has been made. One electric turbine has been in successful operation on Long Island for more than a year. The problems of the control of the mill with varying velocities of the wind have been solved. A suitable storage battery has been provided. A factory at Lewiston, New York, has been acquired and is in operation. The idea, however, is so new that it has not had a great vogue. A few more successful plants in different parts of the country are needed as object lessons. Electricity bids fair to be as useful and convenient to the farmer as it has proved to be to the man in town.

XIX

AGRICULTURAL WASTES

THE Department of Agriculture from time to time publishes bulletins showing agricultural wastes and losses. Typical among these are the bulletins relating to losses produced by insects, including the boll weevil, and to animal diseases of all kinds. Other great agricultural losses are produced either by excessive or deficient rainfall or very extreme vicissitudes of temperature. It appears from a cursory study of this class of literature that the yields of agricultural crops are materially lessened by these losses of various kinds. In other words, the common crops of the country are not so wholly dependent as one might suppose upon the fertility of the soil and methods of culture, but are largely determined by accidents, diseases, epidemics, infections and vicissitudes of the weather.

MAGNITUDE OF LOSSES.

The comparison of the average yield of the principal crops of the United States, from year to year and by periods of five or ten years, indicates that the magnitude of these losses must be pretty nearly uniform. To be sure, there are seasonal variations of considerable importance from year to year, which decrease or increase production, but these causes are chiefly due to the weather and not to the other losses to which I have referred. In the fruit business, especially, the unseasonal frosts, precipitation or drought make wonderful differences in crop production, so much so that even under the best conditions of culture and protection the apple and the peach crops can only be counted on certainly about three out of five seasons in any particular locality. The citrus crops are more uniform, however, in their production, but when an injury comes to them by reason of cold weather it is more profound and enduring than with apples and peaches. Witness the freezes in Florida some twenty years ago and in California during the winter of 1912-1913! Actual damage to trees, amounting even to complete destruction, are not unusual on such occasions, whereas the apple tree and the peach tree are very rarely killed by cold weather. The worst that usually happens to them is the destruction of a single crop, which usually is due to an inopportune frost after budding or flowering. The magnitude of these losses on the whole is very great, so great, indeed, that we are led to believe that if agriculture was subject to no vicissitudes of the kind mentioned, the over production would be so enormous as to render the practice of agriculture practically hopeless from a profit returning basis.

RAVAGES OF HOG CHOLERA.

The losses in live stock also are tremendously large. According to the United States Department of Agriculture, Farmers' Bulletin No. 590, April 23, 1914, more than seven million hogs were lost by disease during the previous year, the value of which to the farmer was $73,000,000. Ninety per cent. of this loss was due to hog cholera. It is estimated that had this loss not occurred, 800,000,000 additional pounds of dressed meat and lard would have been available. This would have given to every family in the United States about forty additional pounds of pork products. It is readily seen that the injection of such an immensely increased quantity of pork products on the market must of necessity have produced a very great decrease in price, so that the farmer probably received as much for the portion of hogs that remained, if not more, than he would have received if all of them had lived. This season (1914) the hog cholera made its first appearance for many years in my neighborhood. To date I have lost thirty-six shoats, mostly pure bred Tamworths, out of forty. Many of my neighbors have been still more unfortunate.

In spite of all the work which has been done by the Department of Agriculture and the States towards securing immunity from hog cholera, it is stated that the loss in the Northern States in 1913 was greater than in previous years, while in the South it was somewhat less. Evidently no success of any notable character has attended the expensive efforts which have been made to secure immunity from this disease. Nevertheless the appropriations for the production of anti-hog-cholera serum are made most abundantly both by the federal government and the States, a far larger sum being devoted to that purpose by the government, and in many of the States, than is directed towards saving the lives of infants throughout the country.

The same bulletin gives the information that the losses of cattle by disease during the preceding year amounted to 1,737,000 head, of a total value of $68,611,000. This includes the losses from exposure as well as from disease. About half of the losses of cattle were due to exposure and about half to disease. In regard to sheep, also, it is stated that the total losses during the year were 2,224,000 head, of a total value of $5,581,000. Nearly all the losses of sheep are due to exposure. The total loss of the meat producing animals due to exposure and disease during the year is estimated to be, in round numbers, $150,000,000. The losses of horses and mules also show approximately 523,000 head, valued at $59,100,000.

While these terrible losses do not seem to diminish the total profits of agriculture to any notable degree, they fall with crushing force upon the farmer who is the victim. They also place a heavy burden on the consumer. Even if the farmer secures no notable gain in the money value of a bumper crop, he becomes thereby a benefactor to the country. If there could be some workable plan evolved to cover the loss to the individual farmer, the wastes mentioned would not menace so seriously agricultural prosperity. If the nation and state could lay a light tax on those articles most subject to destruction for the benefit of those who suffer the losses, less suffering would ensue. If A loses 100 hogs by cholera and thus increases the value of the hogs of his neighbors, it seems to me they should share some of their profits with him. They have made their extra money out of his misfortunes. If A, however, by his own providence could avoid the loss, which would otherwise be due to his own negligence, he would not deserve compensation. When a great flood devastates the Mississippi Delta, driving thousands from their homes and destroying houses, fences and stock, or when a prosperous city like Dayton is submerged and battered, the sympathy of the world is aroused. When drought lays waste great areas in India, the purses of the world are open. When an earthquake destroys a city, aid is offered on every side. When fire consumes a town, the neighboring cities come to the rescue. A great humanitarian association of a purely voluntary character, the Red Cross, is always equipped to succor suffering humanity, dazed by fire or flood or decimated by the Red Dragon of war. The Congress of the United States has voted millions to relieve the victims of disasters of fire, flood and seismic spasms. I wonder what James Buchanan, vetoer of agricultural extension aid, would say to these national gifts and philanthropies? In the face of great disaster and its consequent suffering, we do not wait to consult the constitution. I do not see why the State or the nation, in lieu of these spasmodic gifts to the victims of unavoidable catastrophes, might not institute some form of insurance which would provide automatic and speedy relief. On the other hand, the farmer, as well as every other beneficiary of an insurance of any kind, must be held strictly accountable for his own negligence and indifference. Any system of public or private compensation that would repress industry, dim foresight, or paralyze precaution, would work harm and not good.

These vicissitudes of fortune which I have enumerated, however, do greater damage by the little but persistent wastes which they produce, than do the great cataclysms that overwhelm a restricted area and arouse a world-wide benevolence.

The ravages of insects, the unequal distribution of rain, premature or delayed frosts, the peach borer, local accidents and diseases, the black rust and the blight, are the principal wastes from which the farmer suffers. These are not considered of a character to command attention, excite sympathy, demand remedial legislation, or call for help from the Red Cross.

The time will never come when the fields will yield their maximum output, untouched by storm or stress. It is the part of wisdom, therefore, to recognize these misfortunes and to minimize their results by some system of equal distribution of their burdens.

Some system of insurance against hog cholera, tuberculosis, black leg, lumpy jaw, glanders, foot and mouth disease, and similar epidemic and contagious diseases should be devised. As these diseases, because of the danger of interstate infection, are national in character, the insurance should be of the same kind. The burden on the individual farmer is too great. An epidemic among his farm animals often means financial ruin. No system of corporate insurance would be different from that already in vogue. There are 55,000,000 cattle in the United States. A national tax of one dollar per head would nearly pay for all losses. There are 60,000,000 hogs in the United States. A tax of one dollar would nearly compensate the owners for the destruction by hog cholera.

XX

THE GENESIS OF THE SOIL AND ITS POSSIBILITIES

THE ordinary, intelligent farmer may be very successful, understand thoroughly the principles of agriculture and the methods of applying them, without being a specialist in geology or chemistry. At the same time he is interested in a general way in the genesis of the soil, how it has arisen, what is its constitution, and other scientific facts connected with it. An attempt to present some of the principal facts and theories in connection with soil evolution, without going into the refinement of the sciences or details and illustrations, may be pardoned. Such an attempt I made in an address before the National Geographic Society, in the winter of 1911 and 1912. With the permission of the editors of the *National Geographic Magazine,* Washington, D. C., the address is given below:

THE GENESIS OF THE EARTH.

"One of the oft-repeated theories concerning the origin of our earth is that at a remote period all the matter of which the earth consists at present was a part of the incandescent gas which filled the space now assigned to our solar system. As the cooling of this mass of gas progressed vortex rings were formed of gaseous matter. These on further cooling broke and rolled together, forming the sun, the planets, and the satellites of our present system. The next condition of the incandescent gas was incandescent liquid, which came in due season as time rolled by. Finally, by the further process of cooling, a crust was formed upon the surface of these liquids which was the beginning of the solid surface of the earth. This crust would naturally be of the same composition as the liquid matter from which it was formed — practically homogeneous in character and consisting of the mineral matters only which could exist in a solid state at that temperature.

"Whether the above theory relating to the life history of the planet up to the formation of igneous rock is true or not is of little consequence in so far as the genesis of the soil is concerned. It is certain that the mineral parts of soil are derived from rocks. We may not know how these rocks originated.

THE EVOLUTION OF THE SOIL.

"In speaking of the soils of the United States, I would like to trace briefly their evolution from this primeval crust, which was the first ice formed on this globe. What have been some of the more active forces which have broken up this congealed mineral matter and brought it into the present condition in which we see the surface of our globe? First of all the action of water, which is and has been one of the chief disintegrating agents upon the earth's surface. At the time the first crust was formed over the surface of the earth all the water which now exists must evidently have been above the earth's surface in the form of steam. As the cooling slowly progressed this steam tended to condense in the form of clouds and finally water. Thus the original rain falling upon the hot surface of the earth was at once converted again into steam, but not until it had started a certain solvent action. Water has been termed the universal solvent, and it is not difficult to see how active it must have been at the time of which I speak. The sudden cooling of the surface at the spot where a drop of water struck would tend to crack it, the hot water would dissolve quickly any of the substances soluble therein, and this continual bombardment of boiling water must have had a tremendous effect in disintegrating the original crust formed over the earth's surface. As the earth continued to cool and diminish in size, the original surface wrinkled and formed hills and valleys. The continual descent of water would finally permit some of it to remain in the liquid state upon the earth's surface, and this coursing down the valleys continued the disintegration, both by solution and attrition. The original mineral matters were thus brought into a form of solution or suspension, and, seeking their natural chemical affinities, began to form from the first igneous rocks, the first sedimentary rocks. These are the rocks which we now see in strata, underlying the greater part of the earth's surface. All these stratified rocks must have been laid down under the water, and thus we are convinced that the surface of the earth during the long period of the formation of the soil must have been alternately above and below the surface of the water collected upon the globe.

"When organic life came upon the earth's surface a new disintegrating force was introduced. Organic life, even in its smallest forms, such as bacteria, acts with vigor in decomposing rocks. The larger forms, which produce rootlets, help this disintegrating process along. These roots find their way into crevices of the rocks, and tend to split them open and to admit water below their surface. Certain bacteria also tend to oxidize the nitrogen of the air and form nitric acid, known under the common name of *aqua fortis,* which has a vigorous solvent action on many kinds of rock. Carbonic acid arising from the burning organic matter and from the lungs of animals and preëxisting as a mineral substance also played an important part in rock decay.

"In the process of further cooling, ice was formed, and this also tended to have a disintegrating influence. Water in passing into ice increases in volume, and this tends to break and disintegrate many bodies. Rock saturated with water thus tends to break up when the water becomes ice. During the period of the ice age when large glaciers moved over much of the earth's surface, the crushing and grinding effects of the ice had much to do with disintegrating the rock. The vast areas of glacial drift which form the soil of many of our Central Western States are evidences of the gigantic scale on which these ice mills of the gods slowly ground the stones of the earth into soil. When the soil is formed by the decay of rocks without the transporting action of water or ice being active, the soils are said to be formed *in situ.* When the products of soil disintegration are carried by water and deposited along the banks of the streams or at their mouths, the soil is called alluvial. When products of rock disintegration are carried by moving ice and deposited therefrom, they are called glacial drift. When they are carried by wind, as is often the case, they are called æolian soils. The above are some of the varieties of soils as determined by their method of formation. Soils are also classified in regard to their chemical characters; as, for instance, when formed from the decay of carbonate of lime, they are called limestone soils. When arising from the disintegration of granite, they are called granitic soils. When formed chiefly from particles of silex, they are called sandy soils. When consisting mostly of silicate of alumina, they are called clay soils, and so on."

In addition to the above description there are several points relating to the classification and nature of soils which will prove of value and interest to the general reader. These additional data are compiled chiefly from my work on Agricultural Chemistry.[1]

"The weathering of rocks and their gradual disintegration into the mineral bases of the soil is by many considered to be largely influenced by the freezing and thawing which are incidental to the change of seasons. This is a plausible theory. The effect of freezing is produced, as has already been intimated, by the expansion which takes place when water reaches a temperature only a few degrees above the freezing point. As the water is cooled to this point there is a gradual contraction of volume. At 4° centigrade, which is nearly 40° Fahrenheit, this contraction in the volume of water, as it is further proved, stops, and an expansion in volume takes place at lower temperatures. When the water is crystallized into ice the maximum of expansion is secured. This crystallization, which seemingly is produced by forces of a very minute character, nevertheless goes on with almost irresistible force. The strongest vessels are easily rent asunder by this expansive force of freezing water. The well-known phenomenon of bursting water pipes in cold weather is an illustration of this herculean force. Apparently man can construct no container strong enough to resist it.

[1] "Principles and Practice of Agricultural Analysis," Second Edition, Volume I. Chemical Publishing Co., Easton, Pa.

ROCKS DIFFER IN SPEED OF WEATHERING.

"It is also a matter of observation that certain kinds of rocks are much more sensitive to weathering than others. In the selection of permanent building stones the property of rocks to withstand weathering is extremely important. The breaking down of building stones is usually ascribed to the freezing and thawing process. Those stones which permit the freest entry of moisture, thus storing up water which, when frozen, expands, are as a rule those that most rapidly give way. The action of freezing and thawing, however, has been perhaps somewhat over-rated. In warm or even tropical climates, where these agents are never active in the disintegration of rocks, some of the deepest and best weathered soils are produced. In point of fact, a long hard winter, where there is no thawing at all, tends to preserve the rocks from decay rather than to favor it.

"There are many facts which have been observed by geologists confirming the idea that a warm climate, especially if it be a wet one, is more favorable to rock decay than a cold climate. The progress of decay, therefore, is distinctly affected by latitude. Extensive investigations carried on along the Atlantic side of the country show wide differences in the rate of decay in the same kind of rocks in different latitudes. In general, the progress of decay is more marked toward the south. The same fact is observed in the great interior valleys of the country; at least, everywhere except in the arid and semi-arid regions. Wherever there is a deficiency of water the processes of decay have been arrested. Where the rock strata have been displaced from a horizontal position the progress of decay has been more rapid. This is easily understood. The percolation of water is more easy as the displacement approaches a vertical position.

"A most remarkable example of this is seen in the rocks of North Carolina. A kind of rock known as trap is found in layers called dikes in the Newark system of rocks in that State. These dikes have been so completely displaced from the horizontal position they at first occupied as to have an almost vertical dip. The edges thus exposed vary from a few feet to nearly one hundred feet in thickness. The trap rock in those localities is composed almost exclusively of the mineral dolerite, which is so hard and elastic in a fresh state as to ring like a piece of metal when struck with a hammer. In building a railroad through this region these dikes were in some places uncovered to a depth of forty feet and more. At this depth they were found completely decomposed and with no indications of having reached the lower limit of disintegration. The original hard bluish dolerite has been transformed into a yellowish clay-like mass that can be molded in the fingers and cut like putty. Similar geological formations in New Jersey and further north do not exhibit anything like so great a degree of decomposition, thus illustrating in a marked degree the fact that freezing weather for a part of the year is a protection against rock decay. The ice of winter at least protects the rocks from surface infiltration, although it cannot stop the subterranean solution which must go on continuously.

"Other things being equal, therefore, it appears that as the region of winter frost is passed the decay of the rocks has been more rapid, because water, the chief disintegrating force, acts more constantly. Decay of rocks at the poles must be very slow.

THE ROLE OF WATER IN SOIL MAKING.

"Attention has also been called to the solvent action of water. It is well to consider in this respect the fact that pure water is not, as a rule, so good a solvent as impure. Water especially which contains carbon dioxid in solution, or traces of organic acids, or traces of phosphoric and nitric acids, acts much more vigorously on many rock materials than pure water could possibly do. The water of springs and wells is not pure. It contains in solution mineral matters and often a trace of organic matter. The organic matter comes from contact with vegetable matter and other organic materials near the surface of the earth. The mineral matter is derived from the solvent action of the water and its contents on the soil and rocks.

"The expression 'hard' or 'soft' applied to water indicates that it has much or little carbonate of lime and magnesia or sulfates of the same bases in solution. Water containing much carbonate of lime (or lime and magnesia) in solution is usually more or less charged with carbon dioxid. When boiled this gas is driven off and the carbonates precipitated. This kind of hardness is called temporary. When surface and spring waters are collected into streams and rivers they still contain in solution the greater part of the mineral matters which they at first carried.

"When waters have more than 600 parts of mineral matter per million they are not deemed suitable for drinking waters. Mineral waters, so called, are those which carry large quantities of mineral matter, or which contain certain comparatively rare mineral substances which are valued for their medicinal effects.

"The analysis of spring, well, or river waters will

Photo by U. S. Dept. of Agriculture

SPRAYING SUGAR BEETS

Photo by U. S. Dept. of Agriculture

DISTRIBUTING POISON BAIT FOR CUT WORMS

always give some indication of the character of the rocks and soils over or through which they have passed. The vast quantities of mineral matters carried into oceans and seas are gradually deposited as the water is evaporated. If, however, these matters be very soluble, such as common salt, sulfate of magnesia, etc., they are found in concentrated solutions as is seen in sea waters. In small bodies of waters, such as inland seas, which have no outlet, this concentration may proceed to a much greater extent than in the ocean. As an instance of this, it may be noted that the waters of the Dead Sea and Great Salt Lake are impregnated to a far greater degree with soluble salts than the water of the ocean. The solvent action of water on rocks is greatly increased by the traces of organic (or carbonic) acids which it may contain. When surface water comes in contact with vegetable matter it may become partially charged with the organic acids which the growing vegetables may contain or decaying vegetable matter produce. Such acids coming in contact with limestone under pressure will set free carbon dioxid. Water charged with carbon dioxid acts vigorously as a solvent on limestone and some other mineral aggregates. If such waters penetrate deeply below the surface of the earth their activity as solvents may be greatly increased by the higher temperature to which they are subjected. Hence, all these forces combine to disintegrate the rocks, and through such agencies vast deposits of original and secondary rocks have been completely decomposed. The decay of nitrogenous matters gives rise to nitric acid which also adds to the disintegrating power of percolating waters. The gradual passing of the firm rock into an arable soil is beautifully shown in the illustration.

SANDY AND CLAY SOILS.

"Hilgard has called attention to the fact that soils formed with a small supply of water as in the arid regions have a distinctive sandy character; while those formed under the influence of an abundant supply of water contain more clay. In the decay of rocks, therefore, a dry climate has a distinctly retarding effect on the kaolinization of feldspathic rocks. The soils formed *in situ* on the Atlantic border are therefore chiefly clay loams, while on the Pacific border they contain a larger quantity of sand.

"The preliminary condition to the growth of vegetation is the formation of soil, but once started, vegetation aids greatly in the decomposition of rocks. Some forms of vegetation, as the lichens, have apparently the faculty of growing on the bare surface of rocks, but the higher orders of plants require at least a little soil. Vegetation acts as a rock disintegrant by shading the surface and thus rendering the action of water more effective, by mechanically separating the rock particles by means of its penetrating roots and by the positive action of the root juices. The rootlets of plants in contact with limestone or marble dissolve large portions of these substances, and while their action on more refractory rocks is slower, it must be of considerable importance. It is evident that the solvent action of the acids of living plants is confined almost exclusively to the particles of rocks proximate to points of exudation. The organic matter introduced into the soil by vegetation also promotes decay still further, both directly and by the formation of acids of the humic series. This matter also furnishes a considerable portion of carbon dioxid which is carried by the water and assists in its solvent action.

THE ROLE OF EARTH WORMS.

"Of animal organisms those most active in the formation of soil are earth-worms. The work of earth-worms in soil forming has been exhaustively studied by Darwin. The worms not only modify the soil by bringing to the surface portions of the subsoil, but also influence its physical state by making it more porous and pulverulent. According to Darwin, the intestinal content of worms has an acid reaction, and this has an effect on those portions of the soil passing through their alimentary canal. The acids, which are formed in the upper part of the digestive canal, are neutralized by the carbonate of lime secreted by the calciferous glands of the worms, thus neutralizing the free acid and changing the reaction to alkaline in the lower part of the canal.

"The worms further modify the composition of the soil by drawing leaves and other organic matter into their holes, and leaving therein a portion of such matter which is gradually converted into humus. Darwin estimates that about eleven tons of organic matter per acre are annually added to the soil in regions where worms abound. A considerable portion of the ammonia in the soil at any given time may also be due to the action of worms, as much as 0.18 per cent. of this substance having been found in their excrement. It is probable that nearly the whole of the vegetable matter in the soil passes sooner or later through the alimentary canals of these ceaseless soil builders, and is converted into the form of humus. Finally the bodies of the worms serve to increase the quantity of the organic matter in the soil.

THE ROLE OF BACTERIA.

"The intimate relations which have been found to subsist between certain minute organisms and the chemical reactions which take place in the soil is a sufficient excuse for noting the effect of other similar organisms in the formation of soils.

"In addition to the usual forces active in decomposing rocks Müntz has described the effects of a nitrifying bacillus contributing to the same purpose.

"According to him the bare rock usually furnishes a purely mineral environment where organisms cannot be developed unless they are able to draw their nourishment directly from the air. Some nitrifying organisms belong to this class. It has been shown that these bodies can be developed by absorbing from the ambient atmosphere carbonate of ammonia and vapors of alcohol, the presence of which has been observed in the air. According to the observations of Winogradsky, they assimilate even the carbon of the carbon dioxid just as the parts of plants which contain chlorophyl. Thus even on the denuded rocks of high mountains the conditions for the development of all these inferior organisms exist. In examining the particles produced by attrition, it is easily established that they are uniformly covered by a layer of organic matter evidently formed by microscopic vegetation. Thus we see, in the very first products of attrition, appearing upon the rocky particles the characteristic element of vegetable soil, viz., humus, the proportion of which increases rapidly with the products of disaggregation collected at the foot of declivities until finally they become covered with chlorophyliferous plants.

"In a similar manner the presence of nitrifying organisms has been noted upon rocky particles from high altitudes received in sterilized tubes, and where these are sown in an appropriate environment they soon produce colonies. The naked rocks of the Alps, the Pyrenees, the Auvergnes and the Vosges, comprise mineralogical types of the most varied nature, viz., granite, porphyry, gneiss, mica-schist, volcanic rocks and limestones and all these have shown themselves to be covered with the nitrifying ferment. It is known that below a certain temperature these organisms are not active; their action upon the rock is, therefore, limited to the summer period. During the cold season their life is suspended, but they do not perish, inasmuch as they have been found living and ready to resume all their activity after an indefinite sleep on the ice of the glaciers where the temperature is never elevated above zero.

"The nitrifying ferment is exercised on a much larger scale in the normal conditions of the lower levels where the rock is covered with earth. This activity is not limited to the mass of rock, but is continued upon the fragments of the most diverse size scattered through the soil and it helps to gradually reduce them to a state of fine particles. The action of these ferments is therefore a phenomenon of the widest extension.

"The action of these microörganisms, according to Müntz, is not confined to the surface, but extends to the most interior particles of the rocky mass. Where, however, there is nothing of a nitrogenous nature to nitrify such an organism must live in a state of suspended animation unless it is able to act on the nitrogen of the air.

"When the extreme minuteness of these phenomena is considered there may be a tendency to despise their importance, but their continuity and their generality in the opinion of Müntz place them among the geological causes to which the crust of the earth owes a part of its actual physiognomy and which particularly have contributed to the formation of the deposits of the comminuted elements constituting arable soil.

"Brauner calls attention to the danger of overestimating the activity of nitrifying organisms in effecting the decay of rocks due to their inability to live at great depths. As is well known they diminish in abundance as the depth below the surface increases and disappear, or at least are inactive, at depths of from three to six feet. Brauner says that in these cases the statements of specialists are the only safe reliance and the finding of bacteria in rocks by any one not a specialist is to be regarded with suspicion. Only those who have worked in bacteriology can fully appreciate the difficulties to be enumerated and the precautions to be taken in dealing with those organisms in order to prevent being misled by faulty manipulation.

THE ROLE OF OXYGEN.

"The air itself takes an active part in rock decay. Wherever rocks are exposed to decay, there air is found or, at least, the active principle of air, viz., oxygen. The air as a gas not only penetrates to a great depth in the earth, but is also carried to much greater depths by water which always holds a greater or less quantity of air in solution. The oxygen of the air is thus brought into intimate contact with the disintegrating materials and is present in a condition to assist wherever possible in the decomposing processes.

"The oxygen acts vigorously on the lower oxids of iron, converting them into peroxids, and thus tends to produce decay.

"There are other constituents of rocks which oxygen attacks and thus helps to their final breaking up. It is true that, as a rule, the constituents of rocks are already oxidized to nearly as high a degree as possible, and on these constituents of course the air would have no effect. But on others, especially when helped by water with the other substances it carries in solution, the air may greatly aid in the work of destruction.

"In a general view, the action of the air in soil formation may be regarded as of secondary importance, and to depend chiefly on the oxidation of the lower to the higher basic forms. These processes, while they seem of little value, have, nevertheless, been of considerable importance in the production of that residue of rock disintegration which constitutes the soil.

THE SOIL MORE THAN MINERAL.

"But for agricultural purposes the soil consists of more than decayed mineral matter. By the decay of organic matter there is introduced into the soil the element, humus, which is one of its principal characteristics from an agricultural point of view. The soil is filled with millions of organisms of a lower form, without whose activity the growing of crops would be impossible. The soil, therefore, not only contains the mineral matters which are necessary to sustain the life of plants, but also those organic elements without which these mineral matters would not be available for plant growth. The three principal mineral foods of plants are potash, phosphoric acid, and nitrogen. Lime, magnesia, iron, and many other mineral substances are also found in plants, but these are not absolutely essential to plant growth. If, however, either nitrogen, potash, or phosphoric acid be entirely removed from the environment, it is impossible to produce a matured plant. The great bulk of the material of which plants are composed is not drawn, however, from the soil, but is taken from the air and water. Great as have been the chemical achievements of man, no chemist has yet arisen whose skill can be compared to that of the plant itself. Any chemist who to-day, with all the appliances which science has placed at his disposal, could make by synthesis the various organic compounds of which plants are principally composed would rival the fame of Berzelius, Liebig, Hoffman, Berthelot, Gibbs, or Curie. Thus the soil must be regarded as that part of plant life which furnishes the physical support for the growing plant, supplies it with the mineral foods essential to its growth and maturity, and favors best those conditions which enable the plant cell to elaborate the organic matters of which the matured plant is chiefly composed.

CLASSIFICATION OF SOILS.

"While there is an infinite variety of detail in the character of the soils of the United States as regards physical qualities and chemical composition, they may be classed into three great divisions as regards their origin, and this classification in a measure also classifies them as to physical qualities.

"First are the drift soils of the North, occupying the principal portion of the States lying north of the Ohio and east of the Missouri River. It is a theory of geologists that in a previous age of the earth the northern hemisphere had a very much colder climate than now; that ice in the form of glaciers covered all the more northern latitudes and extended down into these portions of the United States already indicated, producing important effects on the topography of the country. When the ice melted the finely ground rock powder was left, the glacial drift of to-day. This drift, sometimes forming but a thin layer over the underlying rock, sometimes forming a very thick layer, is made up of the mingled materials brought from various geological formations lying to the north of the place where they are now found. The soils of this drift are usually gravelly, often stony, of variable fertility, embracing alike the noted fertile soils of Ohio and of western New York and the most barren portions of New England. As a whole, these soils grow more productive as we travel southward and westward from New England and western New York. As a whole they are durable. When over-cropped and worn out even, as often occurs, they readily recuperate, with rest, by the slow disintegration of the mingled materials of which they are composed.

"According to geologists, the southern limit of this drift-soil extends across Long Island, crossing New Jersey at its upper third; thence across the State of Pennsylvania, entering it and leaving it about midway, entering Ohio near where the Ohio River strikes the State, passing southwesterly, leaving the State near the Ohio River, following along the southern borders of Indiana in or near the southern tier of counties, not crossing the river at all unless it be for a very small region, where the three States of Indiana, Illinois and Kentucky come together; thence westward, crossing the Mississippi above its junction with the Ohio; then westwardly and a little northerly across the State of Missouri, keeping south of the Missouri River, leaving the

State at about Cass or Bates County, and entering Kansas in perhaps Miami County, thence northwesterly, crossing the Kansas River in Riley County, entering Nebraska at or near Jefferson County; crossing the Platte probably at Polk County; thence northwesterly to Holt County. West of the Mississippi River these boundaries are ill-defined, and in all of the Western States there are large areas where the soil is so modified by other influences that agriculturally its drift character is almost wholly lost.

"The second great class of soils occupies the undulating parts of the country lying south of the drift. They have been made by the decomposition of the rocks which have occupied their present position. The natural action of water, air, and the gases which they contain, along with varying temperature, tends to disintegrate the rocks. Even the hardest will weather in the course of time. Some decompose rapidly, others more slowly, but all in such a climate as ours ultimately will be reduced to a soil. The immediate surface disintegrates more rapidly in a cold climate, where frost aids the process, but ultimate chemical decomposition goes on more readily in a warm climate than in a cold one, particularly if it have abundant rains. If a region is fertile and the climate favorable, so that there is an abundant vegetation on the surface, which produces carbonic acid and other solvent products by its decay, the decomposition goes on more rapidly beneath. If the underlying rocks are of limestone, then large quantities of the lime are dissolved, and if the limestones are impure, containing much insoluble matter, the solution of the soluble carbonate of lime leaves a soil composed largely of the insoluble remains. Such soils are often of extraordinary fertility, illustrious examples of which are seen in the so-called blue-grass regions of Kentucky. These soils are well known by reason of their great natural fertility.

"Throughout the Southern States, on the slopes and the uplands, we have a great variety of soils produced by the chemical and the mechanical disintegration of rocks, possessing every variety of character, both as regards chemical fertility and physical texture. Some of them, particularly when produced from certain sandstones, are poor and easily exhausted, and when exhausted do not recuperate readily, of which we have examples in some of the more barren land flanking several of the chains of the Appalachian system. Others possess great power for rapid recuperation, as, for example, the blue-grass region of Kentucky, where the calcareous portions of the soil rapidly disintegrate or are changed by chemical action, and where there is an abundant source of the elements of fertility in the rocks themselves. The state geologist of Kentucky gives interesting illustrations of this power. Certain areas inclosed within the region already described as being occupied by drift have been modified by these same influences. Professor Whitney, former state geologist of Iowa, states that some of the fertile prairie soils of that State — those where the soil is of almost impalpable fineness — have been produced by the slow solution of beds of limestone which formerly occupied their places. In the course of ages, under the influence already spoken of, the insoluble limestone has been dissolved, the solution borne away to the ocean in the rivers, and the small percentage of insoluble residue is left, forming the thick prairie soil of the region, which has since become blackened by the decay of abundant vegetation produced upon it. From the nature of the case we have a very great variety of soils belonging to this class.

"The third class includes all of the alluvial soils formed by deposition from rivers and streams, of which we have such abundant examples about the mouth of the Mississippi. They constitute all the bottom lands of the West, and indeed of the whole country. They also are found in places, particularly in the West, occupying the beds of ancient lakes, a notable example of which is found in the fertile soils of Dakota, popularly known as the Red River region. Here was an ancient lake of very great size, known to geologists as Lake Agassiz, extending southward of Lake Traverse, on Red River, widening northward and extending on both sides of the river, perhaps fifty-five or sixty miles wide; there its bed leaves the country, expanding to much greater width northward in Manitoba. This tract is exceedingly level, the soil of varying depth, very fine, black with the decomposition of vegetable matter, and very fertile. As we proceed westward soils belonging to this class contain less and less vegetable matter, although not necessarily less fertile, until in the valleys of California we have in places soils of great fertility which contain very little vegetable matter (humus). The amount of vegetable matter coloring the soil black depends very largely on the temperature, climate and on the amount of water. There is little of such matter in a dry region or in a region subject to periodical droughts, and yet such a soil may be very fertile in the mineral constituents necessary for grain, and in seasons, with sufficient rain or by irrigation, very large crops may be grown.

"These three classes of soils run into each other by insensible gradations. The classification is given as merely a general one. We may say in a general way that corn flourishes best on soils of the third class, and that it probably is mostly produced there, and wheat on the first and the third classes, more probably being produced on the first class. But individual soils of the second class are even more fertile than those found in either the first or the third.

"A notable example of the soils of the second class is found on the table-lands of eastern Oregon and Washington; the underlying rock is volcanic, which by its decomposition has given rise to a soil of very great fertility and of easy tillage. The experience of the Old World with volcanic soils about the Mediterranean and in the Rhine region, some of which soils have vineyards of great age upon them, indicates that these soils of eastern Oregon and Washington will retain their fertility for a great period, and it is probable will ultimately support a dense population and produce a great variety of agricultural products. This area is now rapidly gaining as a wheat region. Barley and oats grow well, and are of most excellent quality, but the climate is unfavorable to Indian corn."

FURTHER DETAILS OF CLASSIFICATION.

I have given above some of the general principles of the classification of soils, but not in sufficient detail for the information of the farmer seeking knowledge on this important question. In regard to their method of deposition soils are divided into five classes:

1. Those which are formed from the decomposition of crystalline or sedimentary rocks or of unconsolidated sedimentary material *in situ*.

2. Those which have been moved by water from the place of their original formation and deposited by sub-

sidence (bottom lands, alluvial soils, lacustrine deposits, etc.).

3. Those which have been deposited as debris from moving masses of ice (glacial drift).

4. Soils formed from volcanic ashes or from materials moved by the wind and deposited in low places or in hills or ridges.

5. Those formed chiefly from the decay of vegetable matter (tule, peat, etc.).

The importance of a more extended notice of this class of soils for analytical purposes is emphasized by their large extent in the United States.

ALKALI SOILS.

Chiefly through the researches of Hilgard attention has been called to the true character of these soils which are found throughout a large part of the western United States and which are known by the common name of alkali. The following description of the origin of these soils is compiled chiefly from Hilgard's papers on this subject. Wherever the rain-fall is scanty, and especially where the rains do not come at any one time with sufficient force to thoroughly saturate the soil and carry down through the subsoil and off through the drainage waters the alkali contained therein, favorable conditions exist for the production of the alkaline soil mentioned above. The peculiar characteristic of this soil is the efflorescence which occurs upon its surface and which is due to the raising of soluble salts in the soil by the water rising through capillary attraction and evaporating from the surface, leaving the salts as an efflorescence.

Soils which contain a large amount of alkali are usually very rich in mineral plant food, and if the excess of soluble salts could be removed, these lands under favorable conditions of moisture and temperature would produce large crops.

The formation of the alkali may be briefly described as follows: By the decomposition of the native rocks, certain salts soluble in water are formed. These salts in the present matter are chiefly sodium and potassium sulfates, chlorids and carbonates. The salts of potash together with those of lime are more tenaciously held by the soil than the soluble salts of soda, and the result of this natural affinity of the soil for soluble potash, lime and magnesian salts is seen in the formation at the surface of the earth, by the process of evaporation above described, of a crust of alkaline material which is chiefly composed of the soluble salts of soda. In countries which have a sufficient amount of rainfall, these soluble salts are carried away either by the surface drainage or by the percolation of water through the soil, and the sodium chlorid is accumulated in this way in the waters of the ocean. But where a sufficient amount of rain-fall does not occur, these soluble salts carried down by each shower only to a certain depth rise again on the evaporation of the water, reinforced by any additional soluble material which may be found in the soil itself. The three most important ingredients of the alkali of the lands referred to are sodium chlorid, sulfate, and carbonate. When the latter salt, namely, sodium carbonate, is present in predominant quantity, it gives rise to what is popularly known as black alkali. This black color is due to the dark colored solution which sodium carbonate makes with the organic matters or humus of the soil. The black alkali is far more injurious to growing vegetation than the white alkali composed chiefly of sodium sulfate and chlorid. Its presence in very small quantity is sufficient to prevent vegetation.

TREATMENT OF BLACK ALKALI.

This black alkali has been very successfully treated by Hilgard by the application of gypsum which reacting with the sodium carbonate produces calcium carbonate and sodium sulfate, thus converting the black into the white alkali and adding an ingredient in the shape of lime carbonate to stiff soils which tends to make them more pulverulent and easy of tillage.

This method of treatment, however, as can be easily seen, is only palliative, the whole amount of the alkaline substances being still left in the soil, only in a less injurious form.

The only perfect remedy for alkaline soils, as has been pointed out by Hilgard, is in the introduction of underdrainage in connection with irrigation. The partial irrigation of alkaline soils, affording enough moisture to carry the alkali down to and perhaps partially through the subsoil, can produce only a temporary alleviation of the difficulties produced by the alkali. Subsequent evaporation may indeed increase the amount of surface incrustation. For this reason in many cases the practice of irrigation without underdrainage may completely ruin an otherwise fertile soil by slowly increasing the amount of alkali therein by the total amount of the alkaline material added in the waters of irrigation and brought to the surface by the evaporation of the temporarily deeper percolation of the water.

As Hilgard has pointed out, if a soil can be practically freed from alkali by underdrainage connected with a thorough saturation by irrigation, it may be centuries before the alkali will accumulate in that soil again when ordinary irrigation only is practised. It may thus become possible to reclaim large extents of alkaline soil little by little by treating them with an excess of irrigation water in connection with thorough underdrainage.

ADOBE SOILS.

In many parts of the arid regions of this country which can be recovered for agricultural purposes by irrigation the soil has peculiar characteristics.

The name adobe as commonly used applies to both the sun-dried bricks of the arid regions of the West and Southwest, and to the materials of which they are composed. The material is described by Russell as a fine grained porous earth, varying in color through many shades of gray and yellow, which crumbles between the fingers, and separates most readily in a vertical direction. The coherency of the material is so great that vertical scarps will stand for many years without forming a noticeable talus.

The area over which adobe forms a large part of the surface has not been accurately mapped, but enough is known to indicate that it is essentially co-extensive with the more arid portions of this country. In a very general way it may be considered as being limited to the region in which the mean annual rain-fall is less than twenty inches. It forms the surface over large portions of Colorado, New Mexico, western Texas, Arizona, southern California, Nevada, Utah, southern Oregon, southern Idaho, and Wyoming. Adobe occurs also in Mexico and may there reach a greater development than in the United States, but observations concerning it south of the Rio Grande are wanting.

In the United States it occurs from near the sea-level in Arizona, and even below the sea-level in southern California, up to an elevation of at least 6,000 or 8,000 feet, along the eastern border of the Rocky Mountains, and in the elevated valleys of New Mexico, Colorado, and Wyoming. It occupies depressions of all sizes up to valleys having an area of hundreds of square miles. Although occurring throughout the arid region, it can be studied to best advantage in the drainless and lakeless basins in Nevada, Utah, and Arizona.

PEAT SOILS.

The heavy soils whose origin has been described are essentially of a mineral nature. The quantity of organic matter in such soils may vary from a mere trace to a few per cent., but they never lose their mineral characteristics. When a soil on the other hand is composed almost exclusively of vegetable mold it belongs to quite another type. Such soils are called tule, peat or muck. In this country there are thousands of acres of peat or muck soils; the largest contiguous deposits being found in southern Florida. The origin of these soils is easily understood. Whenever rank vegetation grows in such a location as to secure for the organic matter formed a slow decay, there is a tendency to the accumulation of vegetable mold in shallow water or on marshy ground and where other conditions are favorable to such accumulations. In Florida the peaty soils have been accumulated about the margins of lakes. During the rainy season the marshes bordering these are partly covered with water, but the vegetation is very luxuriant. The water protects the vegetable matter from being destroyed by fire. It therefore accumulates from year to year and is gradually compacted into quite a uniform mass of vegetable mold.

The ultimate composition of the mold is illustrated in the following table which shows the character of the layers at one, two and three feet in depth:

Depth	Carbon	Hydrogen	Nitrogen	Vegetable matter and moisture
	%	%	%	%
1 foot....	57.67	4.48	2.24	90.60
2 feet....	47.07	5.15	1.40	72.00
3 feet....	8.52	0.53	0.31	15.00

In this sample, the mold was only three feet deep, resting on pure sand. As the bottom of the deposit is approached the admixture of sand becomes greater and the percentage of organic matter less.

No reliable estimate of the time which has been required to form these deposits can be given, but in the Okeechobee region in Florida the deposit of vegetable mold in some places exceeds ten feet in depth.

The purest vegetable or peat soils contain only small quantities of potash and phosphoric acid, and especially is this true of the Florida deposits which have been formed of vegetable growth containing very little mineral matter.

It is not at all probable that the flora now growing on any particular area of virgin peat contains all the plants that have contributed to its formation. The principal vegetable growths now going to make up the peat soils of Florida are the following:

Common names.

Saw grass	Fern brake
Yellow pond lily	Mallow
Maiden cane grass	Broom sedge
Alligator Wampee	Arrow Weed
Sedge	

The above are only the plants growing in the greatest profusion and do not include all which are now contributing to increase the store of vegetable debris.

NATURE OF HUMUS.

The active principle of vegetable mold is called humus, a term used to designate in general the products of the decomposition of vegetable matter as they are found in soils. In peat and vegetable soils is found a mixture of humus with undecomposed or partially decomposed vegetation.

According to Kostyschoff vegetable matter decays under the influence of molds and bacteria. Molds alone produce the dark colored matters which give soils rich in vegetable matter, their color. One chief characteristic of humus is its richness in nitrogen. Black Russian soil contains from 4 to 6.65 per cent. of nitrogen. This soil is estimated to contain 60,000,000 organisms per gram and much of the nitrogen which it holds must be in the form of proteid derivatives. The first development in decaying vegetable matter is of bacteria and there is a tendency of the decaying matter to become acid. This causes the death of the bacteria and the ammonia produced thereby neutralizes the acid. The various kinds of mold grow when the reaction becomes neutral. Afterwards the bacteria and the molds develop together. This statement of Kostyschoff is not a very satisfactory explanation of even our limited knowledge of the decomposition of organic matters in the soil. Ammonia and ammonia salts are formed not by the decay of some forms of bacteria but by the activities of other forms. It has been found that in nitrification there are three distinct forms of bacteria concerned in the final products of ammonia, nitrites, and nitrates. Humus always contains easily decomposable

Photo by U. S. Dept. of Agriculture

LARVA OF THE COTTON BOLL WEEVIL

Photo by U. S. Dept. of Agriculture

ADULT COTTON BOLL WEEVIL

matter and consequently the rate of decay in similar conditions at any observed periods is nearly the same. In humus which is produced above the water-level Kostyschoff states that all trace of the vegetable structure is destroyed by the leaves being gnawed and passed through the bodies of caterpillars and wire-worms. Under the water-level the vegetable structure is preserved and peat results. The decay of humus is most rapid in drained and open soils. For this reason the presence of clay in a soil promotes the accumulation of humus. Inferior organisms are the means of diffusing organic matter through the soil. The mycelia of fungi grow on a dead root for instance, ramify laterally and thus carry organic matter outward and succeeding organisms extend this action and the soil becomes darkened in proportion. Humic acid in black soil is almost exclusively in combination with lime.

A more common view of the difference between the formation of humus above and below the water-level is that above the water-level there is a very free access of air and even the harder parts of the leaf skeleton can be oxidized through the agency of bacteria, while under the water-level there is a very limited supply of air and this oxidation cannot proceed as rapidly. The harder parts of the leaf skeleton are preserved, and from the freer access of air humus is oxidized more readily in drained and open soils, and accumulates in clay soils where there is less circulation of air.

The quantity of humus in the soils of arid regions is by no means so great as in those of abundant rainfall.

Few of the upland arid soils of the Pacific Coast contain over .4 per cent. of humus, that is the "matiére noire" of Grandeau. This difference according to Hilgard is of importance because the humus of the soil is the chief repository of one of the most costly of the plant foods, viz., nitrogen.

It must not be inferred however that such soils are very deficient in nitrogenous food since it appears that the humus of the arid soil has a higher percentage of nitrogen than that found in soils with abundant water supply.

The real composition of humus is a matter which has never been definitely determined. Composed as it is of many different but closely related substances it has been difficult to isolate and determine them.

At the present time we can only regard the various forms of humus bodies as mixtures of many substances mostly of an acid nature, and resulting from a gradual decomposition of organic matter under conditions which partially exclude free access of oxygen.

Whether humus takes any direct part in the nutrition of green plants is not definitely known. De Saussure held that soluble humus was assimilated directly by vegetables and this is probably the case with those plants, such as mushrooms, which are devoid of chlorophyl.

Liebig held that humic acid is not absorbed by plants and that as such it does not form a part of their food. Humic acid being of a colloidal nature is not well suited to engage in the translations which take place so readily with crystalline bodies in solution and which readily change their location under the stress of osmotic pressure.

Petermann found however that such bodies could be dialyzed in certain circumstances and he succeeded in passing through membranes highly nitrogenized organic matter of an amber color.

I have found that sugar canes grown in peat soils contained a quantity of dark colored organic matter in their sap which persisted even in the raw sugar made therefrom.

I further found that the quantity of amid nitrogen in oats was greatly increased when grown on peaty soil.

The chief functions of humus appear to be to modify the physical conditions of the soil with reference to texture, moisture, absorption of heat and mineral matters useful to plants and especially to hold in suitable form for progressive nitrification the partially decayed nitrogenous principles of vegetable matters.

SOIL AND SUBSOIL.

Many subdivisions have been made of the above varieties of soil, but they have little value for practical purposes. For convenience in description for agricultural purposes, the soil, however, is further divided into soil and subsoil. In this sense the soil comprises that portion of the surface of the ground, usually from four to nine inches deep, containing most of the organic remains of plants and animals and in which air circulates more or less freely for the proper humification of the organic matter, which usually gives a darker color to the soil than to the subsoil. The subsoil proper lies below this, and has usually more characteristic properties, especially in respect of color and texture, as it has been less influenced by artificial conditions of cultivation and the remains of vegetation.

The subsoil extends to an indefinite depth and is limited usually by deposits of undecomposed or partly decomposed rock matter, or by layers of clay, sand or gravel.

Hilgard regards as subsoil whatever lies beneath the line of change of color, or below the minimum depth of six inches. But should the change of color occur at a greater depth than 12 inches, the soil specimen should nevertheless be removed to the depth of 12 inches only, which is the limit of ordinary tillage; then another specimen from that depth down to the line of change, and then the subsoil specimens beneath that line. The depth to which the last should extend will depend upon circumstances. It is always desirable to know what constitutes the foundation of a soil to the depth of three feet at least, since the question of drainage, resistance to drought, etc., will depend essentially upon the nature of the substratum.

It is evident that no rigid definition of the difference between soil and subsoil can be made as the one gradually merges into the other. In general it may be said from the practical point of view that the soil is that part of the surface of the field extending to a depth of nine inches or to the depth turned by good plowing and the subsoil the layer of nine inches in depth immediately underneath the soil.

The Bureau of Soils, of the Department of Agriculture, has undertaken a re-classification and naming of types of soils on a vast scale. The number of such different types which have already been described is probably more than a thousand. This detail of classification is wholly unwarranted from a scientific standpoint, since it gives certain geographic names of localities in great numbers to a soil of practically a single type. Only the utmost confusion can result from an attempt to make permanent such finely drawn differences as are found to exist among soils of this kind. The classification which has been given in the preceding descriptions is entirely sufficient for both practical and scientific purposes. It is unfortunate that such great prolixity of names for slight variations has come into vogue.

VARIETY OF CROPS.

Within the borders of the United States is grown every agricultural crop known to the world. Our soil produces immense quantities of the cereals; of fiber plants, including especially cotton and flax; of sugar-producing plants, including sugar cane, sugar beets, sorghum, and maple trees; all kinds of vegetables and fruits; medicinal plants of great variety; forest products of all kinds, and spices and condiments of every description.

WILL OUR SOILS PRODUCE ENOUGH FOR FUTURE GENERATIONS?

There is one question which constantly presents itself to the mind of the political economist, namely, Is the rate of increase in population to be diminished, or, if continued, will the food supply be exhausted in the near or remote future? In looking for answers to these questions, political economists must consult scientific agriculture. In the application of the principles of agriculture to science is found the only safe response. It is certain that under the fostering care of this country and with wise and well directed engineering, many millions of acres of rich land can be procured for agricultural purposes through irrigation. Science teaches us in many other ways the methods of making the farm, to a certain extent, independent of the variations in rainfall. The true principles of conserving moisture for the purpose of crop production, and of utilizing to the best advantage the excess of precipitation, are now well known and are daily taught to our people. Scientific forestry is increasing the number of trees and bringing large areas into tree culture which before were only featureless plains. What the effect of tree planting will be upon the climate is not known with certainty, but the general impression is that the more abundant the growth of trees, the more readily is moisture preserved for agricultural purposes, while the intensity and extent of floods are diminished.

The true principles of fertilization are annually increasing the average product of the older farm lands of the community. The principles of cattle feeding are introducing important economies into the utilization of farm products. We have no reason to think that the average wheat crop, for instance, in the United States may not increase in the amount grown per acre. An increase of a bushel and a half per acre will give, in round numbers, an increase of sixty million bushels to the crop. The scientific farmer can readily double and treble his crop, and so, without increasing the acreage, supply double or treble the amount of wheat. The same principle is true of other crops. The future soil fertility will increase, not diminish. The average output of each acre will grow. While the capacity of the mouth to consume remains constant through all centuries, the capacity of the hands to furnish food is constantly increasing. In most cases there are two hands to one mouth. We need not fear, therefore, a period of world starvation due to the exhaustion of the food-producing capacity of the soil. If universal hunger does come, it will not be from this cause. It may be — I would not deny it — that the final fate of man on earth is starvation or freezing, but the remote future at which such calamities can occur makes their event for practical purposes infinitely removed. We are now feeding, within the boundaries of the United States, nearly one hundred million people. When in a hundred years from now we are feeding two hundred million people, the quantity of food per head will be no less abundant than at present. In those days now so near at hand agriculture will be more a science and more an art. The fields will all be gardens, and the forests sources of income without destruction. The life of man will be full of amenities which are now denied the tiller of the soil, and the true aristocracy of the earth will be composed of those in direct touch with earth herself.

XXI

WHAT IS BECOMING OF OUR SOILS?

IT is well known to every student of statistical history, and to every practical farmer who has had access at some time or other to what is known as virgin soils, that the natural fertility of a soil rapidly disappears under the methods of American agriculture which have been chiefly in vogue. If one of the theories of the Department of Agriculture is true, namely, that poverty of soil is due to the decay of the organic matter of previous crops leaving poisonous bodies behind, then the virgin soils of this country ought to be at a maximum of poverty when they are first cultivated. If they be of the forest, they have in them the remains of unnumbered years of forest decay. If they be prairie, they have the remains of unnumbered years of root and grass decay. Theoretically, therefore, if the above-mentioned theory is correct they should have reached the minimum of production. On the contrary, such soils always have the maximum of production. It is difficult to keep a crop from growing after the forest has been removed or the prairie sod has been turned. The agriculture of the past has been chiefly the exploitation of these stores of natural fertility.

It is pertinent to ask, how has this depression of soil fertility, as shown in the diminishing crop production, been secured? There are three principal methods which are patent: first, the natural fertility of the soil

Photo by U. S. Dept. of Agriculture

PROBABLY THEY ARE TO DIE OF CHOLERA

HE THINKS OF THE CATTLE FEEDING IN THE FERTILE FIELDS

"The loss of cattle amounted to 1,737,000 heads"

has been removed with the crops. Every harvest takes from the field a certain quantity of its blood. There is carried away with the crop, no matter what it is, more or less of the vital principles on which the growth of vegetation, that is, of future crops, depends. There are removed with the crops certain quantities of phosphoric acid, potash, nitrogen and lime. The ingredients removed which are principally of value are the first three named. It follows that there must be a gradual impoverishment of the soil, no matter how rich it may have been originally, if this drain continues indefinitely.

NATURE AVOIDS BANKRUPTCY.

It is true that there is present in most soils large quantities of phosphoric acid and potash, which, if they could be unlocked in the proportions in which they are needed, might supply the wants of the crop for a hundred or even a thousand years. The greater part of this material, however, is locked up wisely by nature, so that spendthrift man cannot break the bank. If nature had made all its treasures of plant food readily available, starvation would long since have overtaken humanity. It is the nature of man to exploit the soil to the last degree, hence it was a wise invention of nature to make the soil self-protective.

There is a certain limit to what we can get out of the soil. Beyond that it holds its treasures with a firm grip and refuses to part with them. Long years of experience at the Rothamsted Station have shown that the yield of wheat on properly cultivated soil, which will produce from thirty to thirty-five bushels per acre, rapidly declines when crop after crop of wheat and straw are removed from the field and nothing is returned. In the course of fifteen or twenty years of such treatment it is found that the annual average production of that field is reduced to about thirteen bushels per acre, and it is not possible by successive crops to reduce it any further. In other words, nature holds back from the avaricious hand of man all stores of plant food beyond that necessary to produce a minimum crop. Thus nature safeguards the future from the rapacity of the present.

This experimental demonstration at Rothamsted has been verified by the natural results of American agriculture. The virgin fields of our country, suited to the production of wheat, yielded at first from twenty-five to thirty-five bushels of wheat per acre. Now that yield has been cut down to about thirteen or fourteen bushels per acre, and beyond this, apart from seasonal variations, we cannot go. Thus it is evident that up to a certain minimum limit the fertility of the soil is carried off by successive crops when nothing is returned.

This latter condition is typified by many of the fields of this country at the present time. The vast areas that produce wheat and corn have never received any fertilizer up to within the past quarter of a century, and it may be said, even to-day, that in so far as the one hundred millions of acres devoted to corn culture are concerned, a very small percentage of this area is ever fertilized either from the stable or from the factory. This, then, is the road of exit which a large part of the soil fertility has taken.

LOSS BY DRAINAGE AND EROSION.

A second factor in the loss of soil fertility is seen in the drainage waters of the country. When the surface of the soil was covered by forests and by prairie, the protection afforded secured freedom from very great losses by drainage; but when these protective covers were removed, the water which fell upon the soil was not held back by the mechanical effects of the roots and the trees and the grasses, but either flowed off of the surface or rapidly sunk into the soil. While the increase of loss from this source over that of natural drainage under cover has not been great, it should not be lost sight of in accounting for the depreciation of soil fertility.

Perhaps the greatest of the losses in soil fertility, especially in rolling lands of a texture which does not hold well together, is that which is produced by erosion. In many large areas of the United States the soils are so easily washed that even on gently rolling lands it is almost impossible to hold them in place. As you pass down the Southern Railway, you will see on either side thousands of acres of terraced fields. I mean by this that the planting is done on contour lines, so as to keep the rows as nearly as possible level, while an embankment is thrown up so that the water during a shower cannot break over. It is only in this way that the land can be plowed and cultivated without washing. Here we find an extreme type of liability to loss. There are probably no soils except those which are more or less level which do not suffer somewhat from erosion of this kind.

RECLAMATION OF WASHED SOILS.

Twenty years ago I wrote a part of a Bulletin, issued by the Department of Agriculture, on Washed Soils: How to Prevent and Reclaim Them. In this Bulletin the following statements are found:

"The denudation, or washing, of lands on the higher levels of the earth's surface is a process which no human precaution can wholly prevent. It has been one of the most important forces and factors in the geological changes which have so greatly modified the surface of the earth. The present surface of the largest portion of the United States is made up of this 'sedimentary' or 'drift' material which has been moved from the place where it was formed through the disintegration and decay of the old crystalline rocks, by water, wind, or moving ice, and which has accumulated to a depth of hundreds or thousands of feet over nearly the entire surface of the country. It is estimated that the general surface of the land in the area of the crystalline rocks of the Piedmont Plateau has been lowered at least 2,000 feet by this continual washing. This vast amount of material has been slowly removed and deposited elsewhere by the very same agents which we are contending with to-day in our gullied fields; for this denudation, or erosion, is still going on, as it has been for ages past.

"As a rule this denudation is exceedingly slow and the general level of large tracts of country is not lowered more than an inch or two in a hundred years. Where the change is as slow as this it is undoubtedly of benefit to the human race, as in the course of time it must carry off the soil which has been used over and over again for vegetation and expose fresh material to the roots of plants. With this slow change the natural forces are amply sufficient for the decay of the subsoil and for the conversion of this freshly exposed material into a good soil. When the rate of denudation is excessive, however, and more rapid than the natural decay of the subsoil material which is exposed, it may work serious injury to agricultural lands.

VIEW WEST OF CHEVY CHASE, MARYLAND

The fresh granite rock is shown passing upward into material more and more decomposed until it becomes sufficiently pulverized and soluble to support plant life. The roots showing in the upper part of the picture formerly penetrated the decomposed rock, but have been exposed through grading operations

"Along the banks of the Ohio River and in very many portions of the South hundreds of fields that were once covered with sturdy forests of oak, maple, walnut, and pine, and which bore under cultivation, after being cleared of the natural growth, large crops of wheat, maize, tobacco, and cotton, may now be seen furrowed with gullies as with the wrinkles of age, and abandoned to brush and briers.

"A surface layer of good agricultural soil 6 inches deep resulting from the slow and gradual disintegration and decay of rocks and accumulation of humus may have required hundreds of years for its natural formation, and yet it is liable to be washed away in a single storm.

"This excessive erosion, or washing, of lands may be prevented, and the already gullied fields may be recovered, and steep slopes of loose material may be held and prevented from washing:

"(1) By chemical means, in the application of manures and fertilizers and in the accumulation of organic matter, which change the texture of the soil and make it more porous and more absorbent of water, so that there is less to run off over the surface.

"(2) By means of cultivation and underdrainage, which prevent erosion by distributing the surface flow over the ground and increase the amount carried off by underdrainage.

"(3) By reforestation, or the planting of trees, which act mechanically to prevent washing.

"(4) By grass and similar vegetation, which bind the soil grains and prevent their washing away.

"The erosion of a soil is caused by the wearing of the rain and snow waters which can not penetrate into the soil fast enough to be carried away by underdrainage, and which, by reason of the slope or contour of the land, run off over the surface, carrying along particles of sand and clay. When this water accumulates in a depression in the field the force of the torrent may be sufficient to cut out a great gully in a short space of time.

"The extent of washing to which the soil is exposed depends upon the quantity of rainfall in a given time, the slope or contour of the surface, the texture of the soil, the vegetative covering of the surface, and the kind and condition of cultivation. A soil composed chiefly of moderately coarse grains of sand, and having good underdrainage, will absorb the heaviest rainfall without much danger of surface erosion. A sandy-clay soil, on the other hand, into which the water can not percolate with anything like the rapidity of the precipitation, will be washed and gullied by the torrent of water which must flow over the surface.

CHEMICAL RELATIONS OF THE SOIL TO SURFACE WASHING.

"It has been repeatedly shown by experiments and by the experiences of farmers that a soil, as a rule, absorbs water more readily as the content of organic matter and of humus increases. Surface erosion can, therefore, be largely prevented by such a system of cultivation and cropping as will introduce as large a quantity of organic matter into the soil as possible. A very old method of recovering washed and gullied lands is to place straw in the furrows while plowing, the straw not only acting mechanically to hold the soil in place and prevent surface erosion, but also in a very efficient way to increase the quantity of humus, thus making the soil hold large quantities of water which otherwise would have passed off over the surface. In this simple way fields which have been badly washed and gullied and entirely abandoned may be recovered and made highly productive.

"The most important thing in the recovery of waste fields is the incorporation of organic matter of some kind in the soil; pea vines, stubble, briers, or leaves from the forest may be used as a source of the organic matter. The straw from one acre of land which has been recovered, as mentioned above, will be sufficient to start the recovery of another acre, even if this be deeply furrowed with gullies. Where enough organic matter can be used as a surface dressing, this layer helps greatly to retain water and to make the underlying soil more absorbent.

"As soon as a sufficient supply of humus has been accumulated and the lands are brought up to an adequate condition of fertility, clover or grass should be seeded, if the land is at all suited to these crops, or rye, oats, or field peas should be sown to help hold the surface. Little by little, but more rapidly than would be expected from the forbidding aspect of the field, the land can be reclaimed again and made productive through the accumulation of humus and organic matter. A soil containing a fair quantity of humus will wash less readily than one nearly destitute of this matter.

"A soil containing a fair supply of lime is much less liable to wash than one similarly situated and exposed which is deficient in lime. The reason of this is that clays which are deficient in lime, when once brought into suspension by moving waters, will remain in suspension and keep the water turbid for a long time. Clays which are heavily impregnated with lime salts, on the other hand, are in a flocculated state, the fine grains of clay being held together and in contact with the larger grains of sand. This flocculated mass quickly settles and is originally not so easily disturbed and carried off by moving water. A field treated with an abundance of lime is thus less easily washed by heavy rains. The results of investigations by Schulze, Schloesing, and Hilgard have shown in a most emphatic way the beneficial changes which take place, especially in stiff clay soils, by the application of lime.

EFFECT OF LIME ON PHYSICAL CONDITION.

"The change in the physical condition of the soil which is produced by the lime, and which is likewise produced by a number of other chemicals ordinarily used in commercial fertilizers, is another important factor worthy of consideration. A stiff clay soil is practically impervious to the penetration of surface water when it is delivered in such torrents as we are liable to have in our summer storms. A well-limed soil, on the contrary, although it may contain as much clay but in which the particles are flocculated or drawn together, is much more pervious to water, and the amount of water which the soil will carry down through under-drainage is increased, and the excess which has to flow off over the surface is diminished. The surface washing of cultivated fields, especially those which are naturally deficient in lime, can be greatly diminished, therefore, by the free application of this substance to them.

"A number of the ordinary fertilizing materials have an important effect upon the texture of soils and upon the permeability of soils to water, but few systematic investigations have been carried on in this line and not much, except of local importance, has been definitely settled by experiments or by the experiences of farmers."

Thus, by the removal of crops for which no restitution has been made, by the leaching of the soil and dissolving the soluble salts therefrom, and by the erosion and translation of the soil into localities where it can no longer be reached by the plow, millions of acres of once fertile soil have been reduced to a pitiable degree of poverty. As long as new land was available to the American farmer, he gave little attention to the problem of conserving soil fertility and the various means of restoring it. It was far cheaper for him to abandon his worn-out fields and journey to new regions where the land was still virgin and contained all the accumulated fertility of the ages.

THE NEGLECT AND INDIFFERENCE OF THE FARMER.

Fortunately for American agriculture that day has passed, and we now are face to face with the problem of increasing soil fertility since there is no great possibility of increasing the area of arable land. What are the means by which this restoration can be made? They are perfectly simple. First of all, stop the sources of depletion. Feed your field at least as much as you take from it. Second, stop the useless leaching. This can be done by proper cover crops and deep plowing, which will hold the soil water and prevent it from leaching. Third, stop erosion. This is largely a mechanical process at first, but must be supplemented by a series of grasses or reforestations, which will protect from further waste.

It was my good fortune to be active in a practical application of some of these principles while still a young man, and before the ideas of scientific agriculture had become commonly distributed. My father's farm was in the hills near the Ohio River. The land was originally very fertile. It was underlaid with lime-stone and covered with a growth of maple, walnut, and poplar (tulip) trees. The walnuts and the poplars grew to great size and were the worst enemies of the intending farmer. They were valueless for lumber, of which there was already a surplus of supply, and hence thousands of these magnificent trees were deadened, cut down and burned, to get them out of the way of the plow. Soon after signs of danger were manifested. Deep gullies were cut in the hillside. These were filled in and washed over and plowed out from year to year, until finally all of the surface soil was gone. The sub-soil was much less fertile and even more prone to wash. Consequently, in a few years, not more than fifteen or twenty at most, a great number of the cleared fields were reduced to poverty and the crops fell to a minimum.

EARLY EXPERIMENT IN REFORESTATION.

Directly in front of the house was a hillside which had been so worn by erosion that it was no longer plowed. It was left as a bad spot on the landscape, which offended the eye and indicated an unscientific method of agriculture. So much of the soil had been washed off that even grass would not grow on what was left. Only briers and a few weeds could survive. Knowing nothing of the principles of scientific forestry, I got my father's permission to re-forest this area. There were only about two acres of it, but it was sufficient for an experiment. I planted several hundred young locust trees, of which there was an abundant supply in the country, as carefully as I could along the better and richer portions of the remaining soil. Fortunately a hundred or more of these lived and began to grow vigorously. Soon other plants began to come up from the roots, and in the course of a few years the whole surface was covered by a beautiful growth of young locusts. Now, after the lapse of more than forty years, this abandoned hillside is not only a beautiful spot in the landscape, but also supplies fence posts for the whole farm and yields a larger income according to its area than any other portion of the farm. A considerable part of it has also been naturally seeded to maple.

If the farmers' boys throughout the United States on all farms where erosion has played its game would undertake a reforestation in this direction, incalculable benefit would be derived therefrom. But it is not necessary to abandon the cultivation of such eroded areas. The contour system of cropping will usually save them for use. It is true, it requires some labor to lay out the lines of level and build the little embankments. This, however, can be very well done by the plow. A considerable part of the area is unavoidably wasted for arable purposes, as the embankments cannot be plowed up. But on the whole it pays either to reforest these denuded areas or to cultivate them on the contour principle. This process is now in use in parts of the country, and decided progress has been made in recovering the soil from the effects of erosion and protecting it against further injury.

QUANTITY OF SOIL CARRIED.

It is of course impossible to do more than estimate the quantities of soil which are carried from the surface of the fields and forests and emptied into the running streams. Attempts have been made to estimate the quantities of silt carried in some of the great rivers. The Geological Survey has made a number of estimates of this kind, and has come to the conclusion that the quantity of silt carried by the Hudson River is 240,000 tons a year; by the Susquehanna, 240,000 tons; by the Roanoke, 3,000,000 tons; by the Alabama, 3,000,000 tons; by the Tennessee, 11,000,000 tons; and by the Missouri, 176,000,000 tons.

In the Yearbook of the Department of Agriculture for 1913, Mr. Davis gives an estimate of the losses which occur to agriculture from erosion of the soils. He says:

It has been estimated that the Mississippi River, which drains over one-third of the area of the United States, delivers to the Gulf of Mexico from 370 to 680 million tons of suspended material yearly. Accepting the lower figure and assuming a lower rate for the rest of the United States (500 million tons), the total amount of soil material carried to the seas amounts to 870 million tons a year. Assuming that one-half of this is unnecessary waste, there is an annual loss of over 400 million tons of soil material. This means a preventable waste yearly of more material than was removed in digging the Panama Canal. But this is only part of the story, for only a small portion of the soil brought down from the hills is carried to the mouths of the rivers. What proportion it is impossible to estimate. . . .

Some idea of the extent of this loss may be gained from the fact that the National Conservation Conference in 1909 reported nearly eleven million acres of abandoned farm land in the United States, most of it damaged and over one-third or about four million acres actually destroyed by erosion. At an average original value of $10, the loss amounts to $40,000,000. The loss from non-production is probably as much yearly. Added to this the losses to navigation and water power and the expense of keeping open channels will almost double the amount, so that annually the United States is suffering the loss of seventy-five to one hundred million dollars through the agency of erosion.

FACTORS DETERMINING EROSION.

A remarkable study of soil erosion has been made by the late Dr. W. J. McGee, who was an expert in charge of soil water investigations of the Bureau of Soils. According to McGee's conclusions the amount of erosion which takes place in any locality is determined by a number of factors. First of all the quantity of precipitation is an important factor, but not quite so important as the exaggerations of precipitation. A rainfall of forty inches a year which is distributed evenly throughout every month, being a little over three inches per month, and this distributed evenly throughout the month, might produce no erosion at all; while, on the other hand, a rainfall of fifteen inches a year which should come all at once, or within a short period, would produce very decided erosive effects.

Aside from the amount and distribution of the rainfall, the contour of the land and the texture of the soil are important controlling factors. In land that is practically level erosion is reduced to a minimum; the more hilly the land, the greater the erosion, other things being equal. A soil that is tenacious, contains plenty of lime, and at the same time porous, is least subject to erosion; while a soil that is sandy, devoid of humus, and containing little lime, is most prone to erosion.

McGee calls attention to the amount of precipitation in the United States. In the mainland of the United States, exclusive of Alaska and the insular possessions, the mean annual rainfall, as shown by the reports of the Weather Bureau, averages about thirty inches. The total quantity of water precipitated amounts to 215,-

000,000 cubic feet. It is estimated that this is equivalent in volume to ten Mississippi Rivers running constantly.

FRUIT OR NUT BEARING TREES IN REFORESTATION.

Professor J. Russell Smith, of the University of Pennsylvania, who has made a careful study of soil erosion in this and other countries, is of the opinion that of all the means proposed for controlling soil erosion, including the terracing of the fields, deep plowing, pasture, grass crops, et cetera, the most important and effective is reforestation of some kind. The growing of ordinary forest trees, which are valuable only for their timber, postpones to so remote a date any income that the ordinary farmer is slow to consider the merits of the proposition.

As I have already pointed out, there are certain kinds of trees, like the locust, which will be available for fencing in perhaps fifteen or twenty years. Lumber trees, however, such as the tulip or poplar tree, and the oak, require even a longer period before the beginning of their harvest. Other kinds of lumber trees, such as the pine, require still longer time. Professor Smith is of the opinion, therefore, that the reforestation should be accomplished by the means of crop-producing trees. Among these first of all is the fruit tree. The orchard, however, is hardly possible on land already denuded and in which erosion takes place on the smallest provocation. There is not much of the eroded soil of the United States which can be planted to the tree which Professor Smith considers to be the king of all crops, namely, the date tree.

He recommends as a suitable covering for soil subject to erosion what he calls tree forage. He finds forage tree crops are extensively cultivated in Europe, Africa and Hawaii. The carob and mesquite bean he regards as a substitute for bran and corn meal, and the yields of these crops are, according to Professor Smith, "almost staggering in their significance." He states that mesquite forests on rough, untilled and untillable land are producing from four to ten tons of beans per acre and the bean meal sells at $25 a ton. Among the trees which are available for this kind of a crop he calls the honey locust in the East a counterpart of the mesquite in the West.

The utilization of oak and hickory trees for the production of mast, that is, acorns and nuts, well suited to the fattening of pork, has been known since this country has been settled. In addition to these the beech tree of Kentucky and southern Indiana is a fine mast-producing tree. It requires, however, from twenty to fifty years to produce an oak, hickory or beech tree of sufficient size to produce enough nuts for commercial purposes. In addition to these Professor Smith suggests the fig and the mulberry trees.

THE PECAN TREE.

The most promising of the trees suggested as tree crops are the pecan, the walnut, the almond, the filbert and the hazelnut. The chestnut not only produces a considerable quantity of oil, but also a large quantity of starch, so that the chestnut is almost a bread-producing nut. This form of tree crop is to be recommended especially because it produces its fruit within a few years. If the cultivated chestnut be grafted onto the native stalks, paying crops can be expected in from three to five years. Just at this moment, however, there is a threatening pest which bids fair to destroy the chestnut groves of the United States, namely, the chestnut blight, which, taking its origin in the northeast, has already reached northern Virginia.

It is possible that the artificial planting of many of these valuable trees, especially the leguminous varieties, such as the locust, might be interspersed with the terracing of the surface so that the two might work together for holding the soils. The locust enriches the soil where it grows by increasing its store of nitrogen. The new embankment of the terrace might, therefore, be planted with rows of locust trees, which permit cultivated crops to be grown close up to their trunks.

All of these methods of restraining the action of water naturally tend to hold the water in the locality where it falls, and thus to increase the amount available as soil moisture for crop growth. It would of course be disastrous if water could be so held that it never would percolate. The soluble materials which come from the decay of rocks in the form of alkaline compounds would so increase, if there were no underdrainage, as to produce everywhere in the course of many years that condition which is called alkaline, and which in excess is so fatal to plant growth. It appears, therefore, that among the various methods which have been recommended for the control of soil erosion, especial attention should be paid to reforestation in general or to reforestation with crop-producing trees in particular.

But this is not sufficient. Restitution must be made for the robbery of the past. If the land has been reduced to the very lowest degree of penury, it is necessary to purchase, in order to begin its restoration, additional quantities of phosphoric acid, potash and nitrogen. With this purchase of plant foods a new growth of crops can be instituted, and with a judicious addition of lime, clover and other leguminous crops can be made to grow and thus furnish one of the most expensive of the elements of the fertilizing materials, namely, nitrogen, in a state suitable for plant life. There is no reason, therefore, to despair of agriculture because of the improper method by which it has been conducted in the past years. Every person who engages in that honorable profession at the present time should be imbued with the idea that he has come into the presence of wrongs which are to be righted. Restitution must be made. The land must be respected. It must be restored to its pristine fertility.

XXII

THE FERTILITY OF THE SOIL

THERE is no problem of greater importance to the prospective farmer than the fertility of the soil. The idea conveyed by the above expression is extremely indefinite to most persons. It is generally known that the crops vary from year to year and from field to field. The causes of this variation are well known in many respects. They are largely seasonal. The amount and distribution of the rainfall, the amount and distribution of heat, and the amount and distribution of light, are very potent factors in vegetable growth. If the farmer could have available three inches of water per month for the growing months of May, June, July and August, he would need only a foot of rainfall to produce a magnificent crop. Unfortunately for the farmer, he does not control the natural distribution of water. In this respect the irrigation farmer has a great advantage, and thus the magnitude of the crop under irrigation can be foretold with a great deal of certainty.

WHAT IS FERTILITY?

Aside from the seasonal variations of water, heat and light, there are other causes which control the magnitude of the crop. These causes are grouped together under the term "fertility." To describe fertility in a single phrase is rather difficult, but not impossible.

From my point of view fertility, seasonal variations eliminated, is the measure of the ability of the soil to feed a growing crop. This ability rests upon two fundamental conditions: First, porosity of the soil, by means of which the roots can go out after their food; and second, the amount of food available.

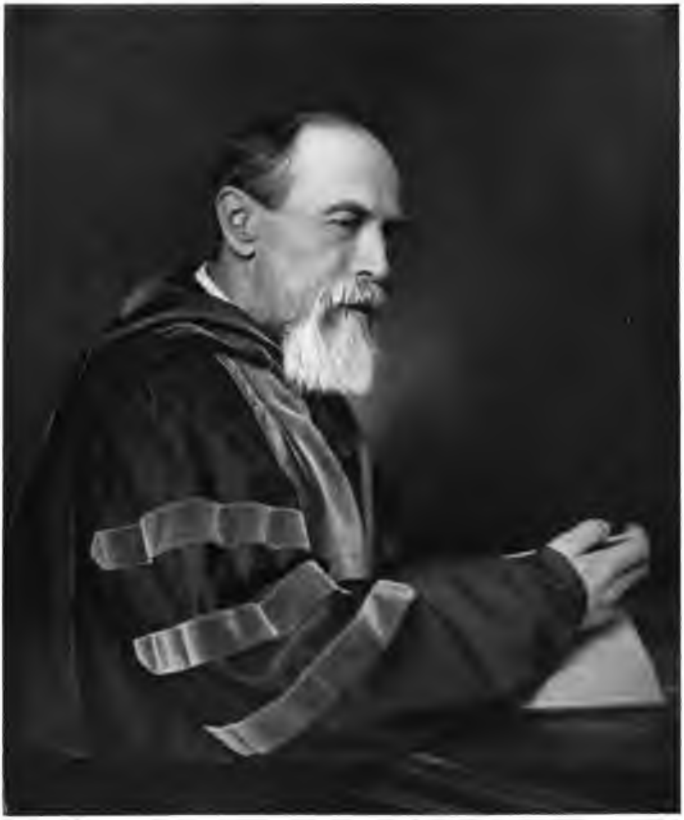
It is well known that plants live chiefly on inorganic materials, consisting mostly of compounds of potassium, phosphorus and nitrogen. There are, indeed, other essential food elements, such as lime, iron, magnesia, et cetera, but as a rule these, with the exception of lime, are always present in much greater quantity than is needed in tillable soils. The compounds of phosphorus, potash and nitrogen, may be locked up in such a way as to be inaccessible for the food requirements of the plant. The usual form of the phosphorus compound in the soil is its union with lime, forming phosphate of lime. Phosphate of lime in its natural state is quite insoluble in the soil waters, and hence the mere presence of phosphoric acid in combination with lime is not always a proper guarantee for a supply for the growing plant.

The same is true of potash, and to a less degree of nitrogen. Many nitrogenous compounds exist in the soil in an undecomposed, organic state, in which condition they are useless as plant foods. These nitrogenous compounds must be broken down under the influence of bacterial action, and the nitrogen converted into nitric acid by a series of ferments which are capable of producing nitric acid from the organic matters containing the nitrogen. It is only in the form of nitric acid that nitrogen reaches its full measure of ability in the nourishing of plants. The potassium may exist in the soil as one of the components of granite or feldspar, and in this condition be wholly inaccessible for food purposes. These compounds must be broken down and the potash liberated before its maximum of utility is obtainable. Potash is especially useful in growing root crops such as potatoes, and in many soils, such as the blue grass region of Kentucky, adds greatly to the yield of Indian corn.

IMPORTANCE OF HUMUS.

Another thing which a fertile soil requires is a lot of decaying organic matter, known as humus. In the decay of organic matter not only is nitric acid formed from the protein which is present in the material, but also the salts of potash and phosphoric acid which are present in the organic materials are set free in a form suitable for plant nutrition. In addition to this, the presence of the decaying organic matter known as humus profoundly modifies the physical condition of the soil, rendering it more porous, more retentive of moisture, and more easily cultivated.

To supplement any deficiency in plant foods, manures and fertilizers are to be freely used. The common understanding of the difference between these bodies is that a manure is something produced on the farm, principally by the farm animals, while a fertilizer is a manufactured article sent from the centers of manufacture for the use of farmers. High-grade fertilizers containing 4 or 5 per cent. of potash, 2 to 4 per cent. of nitrogen-bearing materials, and 8 to 12 per cent. of available phosphoric acid, are applied to soils in large quantities in order to furnish materials for vigorous plant growth. The fertility of the soil, therefore, is simply its feeding ability. The difference between a poor soil in this respect and a rich one is that which is



PROF. E. W. HILGARD
Dean of Agricultural chemists in the United States

found between the larder of poverty and the larder of wealth. It is not even a question of age. Some of the old fields on my farm are not too poor to grow luxuriant oats on which a carelessly tossed hat finds a safe resting place. This is the simple statement of facts established by experience and investigation of the ages, and especially of modern scientific discoveries.

THE BUREAU OF SOILS.

Various collateral theories have been urged in regard to soil fertility by many different investigators. The Bureau of Soils, of the Department of Agriculture, some twenty years ago advanced the theory that all soils without distinction contain an abundant quantity of plant foods, and the soil solution must necessarily become saturated with these constituents to the same degree of concentration in all soils, irrespective of the amounts of phosphoric acid and potash there may be present. In speaking of this theory Mr. Alfred Daniel Hall, of the Rothamsted Experimental Station, makes the following observation:

> Little as this view would seem to square with our experience of the effects of phosphatic and potassic fertilizers on particular soils, the theory of a soil solution of constant composition must be valid if the conditions existing in the soil are such as postulated.

This theory of soil fertility is not accepted by soil specialists such as King, Hilgard, Hall, Hopkins, nor by any great number of agricultural chemists.

In addition to the above theory the Bureau of Soils has advanced the theory that lack of fertility in the soil is due largely to the residual toxic substances which are left in the soil from previous growth, and hence that a neutralization of these toxic substances by proper antidotes is sufficient to restore the soil to its pristine fertility. This theory of the Bureau of Soils has not gained a much wider vogue than the original one in regard to the sufficiency of all soils to supply the phosphoric acid and potash necessary for growth. This theory was also experimentally tested by Hall, and as a result of the investigations in both lines of study the following conclusions were drawn:

(1) The composition of the natural soil solution as regards phosphoric acid and potash is not constant, but varies significantly in accord with the composition of the soil and its past manurial history.

(2) Within wide limits the rate of growth of a plant varies with the concentration of the nutritive solution, irrespective of the total amount of plant food available.

(3) When other conditions, such as the supply of nitrogen, water, and air, are equal, the growth of the crop will be determined by the concentration of the soil solution in phosphoric acid and potash which, in its turn, is determined by the amount of these substances in the soil, their state of combination, and the fertilizer supplied.

(4) On normal cultivated soils the growth of crops like wheat and barley, even when repeated for 60 years in succession, does not leave behind in the soil specific toxic substances which have an injurious effect upon the growth of the same or other plants in that soil.

The net result of these investigations is to restore the earlier theory of the direct nutrition of the plant by fertilizers. The composition of the soil solution which determines the growth of the plant is dependent upon the amount and the mode of combination of the phosphoric acid and potash in the soil, both of which are affected by the fertilizer supply, though to what extent is not yet determinable.

It is evident that the consensus of scientific opinion supports the results of Mr. Hall's investigations, and therefore any failure of a soil to produce a crop, aside from seasonal variations, must still be regarded to depend solely upon its physical state and upon the quantity of plant foods which the soil contains available for nutritive purposes. Thus the common practice, which has been so justified by experience, of heavily manuring the soils and adding the special forms of commercial fertilizers necessary to supply any deficiency, is the only method by means of which abundant crops can be produced in imperfect soils.

HUMUS AS A MEASURE OF FERTILITY.

The indeterminate position of the Bureau of Soils regarding soil fertility is still further illustrated by a recent publication under date of May 6, 1914, in which, in tabular form, are given the yields on soils varying in their percentage of humus. In North Carolina, where the percentage of humus in the soil is given as 1½ per cent., the yield of corn in bushels per acre is given as 20. In Virginia, with the humus content of the soil 2¼ per cent., the yield is given at 30 bushels. In Ohio and Illinois, with a humus content of 5 per cent. in the soil, the yield is given at from 45 to 50 bushels.

There are two or three uncertain factors in regard to this case. First, there are no extensive data compiled by the Census Office of the yields of corn classified as to the content of humus in the soils. In the second place, the content of humus in a soil is due largely to its fertility, and the fertility is not due primarily to the content of humus. The puzzling nonsequential reasoning of the officials is accentuated by the following statement: "The striking correlation between the per cent. of vegetable matter in the soil and the yield of corn in these areas investigated is another strong link in the chain of evidence that organic or vegetable matter in the soil is the most effective factor in soil fertility." The answer to this is that a most luxuriant crop can be grown in pure sand with mineral fertilizers and not a trace of humus.

The changing attitudes of the Bureau of Soils on soil fertility are represented as follows: A. All soils have sufficient plant food for the production of crops indefinitely. B. The fertility of the soil is affected by toxic principles left in the soil from previous crops. C. The fertility of the soil depends chiefly upon its physical state, and the function of applied fertilizers is not one of nutrition, but one of modification of physical character. D. The fertility of the soil depends chiefly upon the amount of vegetable matter it contains.

It is to be hoped that in the near future the Bureau of Soils will reach the conclusion which is now held by all prominent scientific investigators in the world, namely, that the fertility of the soil is dependent upon its ability to feed the crop. All factors which affect that ability are factors in soil fertility.

INCREASING NITROGENOUS FERTILIZERS.

In regard to the nitrogenous constituents of the soil, however, happily a discovery has been made which means much to scientific agriculture, namely, the fact that a certain family of plants, the leguminous family, of which the pea, the bean, clover and locust trees, are types, has the remarkable faculty of assimilating atmospheric nitrogen and converting it into nitric acid in a form suitable for plant nutrition. This remarkable phenomenon is due to the fact of bacterial action. The nitrifying bacteria live in connection with the plant itself, being parasites upon the plant roots, and in this symbiotic activity seem capable of directly oxidizing atmospheric nitrogen and thus increasing in the soil the stores of available nitrogenous foods for plants.

This discovery, so important to agriculture, is all the more to be prized because in the purchase of commercial fertilizers those containing available nitrogen are the highest priced. The cost of phosphoric acid and potash is comparatively low when considered in connection with the cost of nitric acid or nitrate of soda, the form in which, as Chile saltpeter, the available nitrogen of commercial fertilizers is chiefly furnished. The farmer who wishes, therefore, to increase the fertility of his soils, may well begin on this theory, namely, the great majority of soils of the United States are essentially acid, being composed largely of silica or silicic acid. Further, when soils have been long in cultivation their acidity undoubtedly increases, due to the development of acids from the decay of organic matter and the removal of bases from the soil for the purposes of plant growth.

BENEFITS OF LIME.

These old acid soils no longer are capable of producing leguminous crops, but when they are treated with lime they again, under proper conditions, grow abundant crops of clover, alfalfa, cowpeas, and other leguminous plants. By plowing these crops under when near maturity, not only is an abundance of available nitrogen returned to the soil, but also large quantities of humus, which improve the physical condition of the fields. The farmer thus needs only to buy the cheaper potash and phosphoric acid salts in order to restore his fields to the maximum of fertility. It may be possible to find supplies of potash in the United States. All other kinds of fertilizer we have.

A NEW DISCOVERY BUT NOT A NEW IDEA.

The discovery of the value of the leguminous crops as fertilizers, and the method especially by means of which their fertilizing properties are made possible, is supposed to be of modern origin. This is true in so far as the activity of certain nitrifying organisms which have a symbiotic life with the legumes themselves is concerned. The underlying idea, however, is fully set forth by John Taylor, who almost a hundred years ago published an agricultural journal under the name of *Arator* (the plowman). John Taylor was a resident of Caroline County, Virginia, and a hundred years ago was president of the Agricultural Society of Virginia. In these essays, which appeared in the sixty-four numbers of the *Arator,* some of the fundamental principles of scientific agriculture as they are understood to-day were first set forth. In one of his essays Mr. Taylor says:

Land in America affords little pleasure or profit, and appears in a progress of continually affording less. Virginia is in rapid decline; land in New York formerly producing twenty bushels to the acre now produces ten. Little profit can be found in the present mode of agriculture of this country; and I apprehend it to be a fact that it affords a bare subsistence. Virginia is the southern limit of my inquiries, because agriculture had there already arrived to its lowest state of degradation. The land owners in this State are, with few exceptions, in low circumstances; the inferior rank of them wretched in the extreme. Decline has pervaded all the States.

These conclusions, if true, are awfully threatening to the liberty and prosperity of a country whose hostage for both is agriculture. An order of men earning a bare subsistence, in low circumstances, and whose inferior rank is wretched in the extreme, cannot possibly constitute a moral force adequate to either object. It is therefore highly important to the agricultural class to ascertain whether it is true that agriculture is in a decline. . . .

The terrible facts that the strongest chord which vibrates in the heart of man cannot tie our people to the natal spot, that they view it with horror, and flee from it to new climes with joy, determine our agricultural progress to be a progress of emigration and not of improvement, and leads to an ultimate recoil from this exhausted resource of an exhausted country.

EARLY RECOGNITION OF THE VALUE OF CLOVER.

Mr. Taylor continues to discuss, in other numbers of the *Arator,* the true source of nitrogen for the farmer:

We must restore to the earth its vegetable matter before it can restore to us its bountiful crops. Facts demonstrate that by the use of vegetables we may collect manure from the atmosphere with a rapidity and in an abundance far exceeding that of which we have robbed the earth. To draw from the atmosphere the greatest quantity of manure to check the loss the earth sustains from evaporation during the process of shade, to give the manure the most lasting form, and to deposit it in the most beneficial manner, are primary objects of the "inclosing system." The best agent known for effecting the three first is red clover. Its growth is rapid; its quantity exceeds the product of any other grass; it throws up a succession of stems in the same summer, and these stems are more solid and lasting than those of other grasses. These successive growths constitute so many distinct drafts from the great treasure of atmospherical manure in one year. While these drafts are repeated the clover is daily securing the treasure in a form able long to elude the robber, evaporation, whom it also opposes by shade. To the extracting from the atmosphere the greatest quantity of manure and elaborating it into a lasting form the most suddenly of any vegetable cover, clover lays for wheat are indebted for their fame. The tap root of the clover also advances the intention of the "inclosing system" in several respects. By piercing the earth to a considerable depth apertures or pores are created for imbibing; and sinking deeper, a greater quantity of atmospherical manure, so well defended by the shade of the top, and the friability thus communicated to the soil affords a most happy facility to the plow for turning its vast bed of vegetable matter.

Auxiliaries to clover powerfully accelerate its growth. The peculiar property of clover to be improved by a top-dressing of gypsum is another striking circumstance of its affinity to the system of fertilizing land by its own covers. As its growth is vastly increased by this top-dressing, it furnishes reason to believe that the effect flows from a disposition communicated by the gypsum to the clover for imbibing atmospherical food in its external parts, and so much as it thus gains affords to the earth a double benefit. In some lands clover will not live; recourse must therefore be had to other measures of improving the land to endow it with a capacity to produce it, and substitutes for clover should be sought out by experience among the individuals of the vegetable world.

These prophetic extracts from the writings of John Taylor are taken from the *Arator* for 1810, and I am indebted to Dr. John R. Page, of the University of Virginia, for having had my attention called to this most important matter. The extracts which I have published are found in the paper presented by Dr. Page to a Convention of agriculturists on January 29, 1883, at Washington. This Convention was called by George B. Loring, the Commissioner of Agriculture, and is the parent of the splendid organization of the agricultural and mechanical colleges and experiment stations of the country which now wield so great a force for the improvement of agriculture.

XXIII

DRY FARMING

A SERIOUS problem affects the farmers of this country, not only on that fringe which separates the arid from the wet portions of the community, but also as it affects the farmers who live in the so-called wet zone. I have now had five seasons' experience on my farm in Virginia. The first season was an ideal one respecting the distribution of the rainfall in the spring and summer. There was neither a drought nor an excess of rainfall at any part of the growing period. I had an encouraging success in growing crops which are peculiarly susceptible to the effects of drought, my first oat crop averaging 57 bushels to the acre, which was a revelation to the farmers of my vicinity, who were used to securing only from 20 to 30 bushels of oats per acre. The Indian corn crop was also most excellent, yielding a larger return than any crop that has been grown since.

During the last four years there has been an excessively dry May. This unseasonal dry weather has shortened every single grass crop, with the one exception of alfalfa. As I have grown alfalfa only one year in the five, I haven't had much benefit from this exception. Clover and timothy have been almost entire failures, not averaging on my farm over three-fourths of a ton per acre. The wheat has been uniformly shortened in its growth, and thus made somewhat difficult of harvest. The heads have also been very short and not well filled.

This present season, 1914, May started with a promise of the most wonderful clover and wheat crop that had ever been seen. From the fifth of May until the thirteenth of June there was hardly sufficient rain to lay the dust. The contrast was made greater by the fact that the spring had been excessively wet, and much of the plowing had been done when the ground was too wet for that purpose. The result was cloddy fields. Indian corn planted after the twentieth of May in many cases failed to germinate. The wheat was suddenly cut short in its growth but nevertheless yielded a bountiful harvest. The clover, which promised a phenomenal yield, was cut down to less than a ton per acre, and the pastures, which should be green at this season, were dry and brown.

This condition of affairs, as I have said, has been encountered in four seasons out of five. The problem of dry farming, therefore, is one which is peculiarly important to the farmer situated, as I am, in a region of usually abundant rains, but which is subject at some period of the growing season every year to injury by drought.

FIRST OFFICIAL EXPERIMENT IN DRY FARMING.

The subject of dry farming has received a considerable degree of attention from the Department of Agriculture. Crops of considerable magnitude have been grown on areas which a few years ago were supposed only to afford foliage in the early part of the year. I recall in this connection the first experiment made by the Department of Agriculture, in so far as I know, in the principles of dry farming. During the seasons from 1885 to 1902 I was in charge of experiments in the production of sugar and syrups from sorghum, sugar cane and sugar beets, in various parts of the United States. A model factory for the production of sugar from sorghum was erected at Medicine Lodge, Kansas. This was in the midst of the season of lean years in that State, where whole townships in the western portion of the states were depopulated by reason of a series of years of little rain.

Sorghum is a dry farming crop. I have called it, and I think appropriately, the camel among cereals. Its first growth is slow and precarious. When once, however, its root system is developed, it will grow and thrive where Indian corn will wilt and shrivel. The sorghum for the experimental work was grown upon the farm of Eli Benedict, adjoining Medicine Lodge, Kansas. In the winter of 1888 the field which was to be seeded to sorghum, about thirty acres, was plowed and subsoiled. In this way it was made to hold practically all the rain that fell during the winter and spring. There was almost no run-off from this field. The summer of 1889 proved to be an excessively dry one, as its predecessor had been. Indian corn in the vicinity of Medicine Lodge was almost a complete failure. The sorghum, however, which was planted in this field grew apace and made a splendid crop.

The practice which I have just described is the fundamental principle of dry farming. The Department of Agriculture thus may be regarded as having made the first practical experiment in dry farming on record. This system of preparing a deep seed bed which will hold all of the moisture that falls, and of keeping the surface of it well mulched and stirred by frequent plowing to prevent evaporation, is the fundamental principle of all the dry farming that is carried on in the United States to-day. I am convinced that the farmers of Virginia and other places similarly situated must act in accordance with this principle.

DIFFICULTIES OF DRY FARMING.

In the soils of Virginia, especially those in Loudoun County, the difficulties of dry farming are indeed very great, but not insurmountable. These lands have been in cultivation, many of them, more than two hundred years. Loudoun County was the first settlement in Virginia after Jamestown. Its superb virgin soil attracted the attention of the early immigrants, and therefore it was quickly settled. At the time of the American Revolution, Loudoun County was the most populous county of Virginia. It contained, in round numbers, nineteen thousand inhabitants; at the present time its population is only a little over twenty-one thousand.

The system of agriculture in vogue in Loudoun County has been that generally practised throughout the United States, namely, shallow plowing and continued cultivation in such crops as corn, wheat, oats and timothy. All of these crops take valuable nourishment from the soil and yield practically nothing in return. The result is easily predicted. Underneath the surface which has been stirred by the plow is a firm, almost impervious, clay sub-soil. In addition to this it is very thickly studded with small and large rocks, which interfere seriously with sub-soil operations. Yet I feel perfectly certain that this crust must be broken through so as to deepen the seed bed if we are to escape the vicissitudes of the drought which is almost certain to visit this part of the State during the growing season.

I have tried various methods of inaugurating dry farming in Loudoun County. The common sub-soil plow which follows the ordinary field plow is hardly sufficient to secure the purpose in view. It is so easily thrown out by a stone, and so difficult to insert except when the land is really too wet to plow, as to make its general application problematical. I have now experimented with a deep tilling plow made of a double disc of steel, one disc following the other. I have gone far enough with this work to believe that if taken at the proper time and consistence, just when the land has been thoroughly wet to a great depth and is just dry enough to plow, but not too dry, this double disc will penetrate the clay sub-soil and produce a seed bed to a depth of from fifteen to sixteen inches. If this could be accomplished, the Virginia farmer would be able to snap his fingers at the annual dry spell which he experiences. What is true of Loudoun County is true of the whole area of the United States where the rainfall is supposed to be sufficiently abundant to produce a crop.

The deepening of the tillable soil in the manner described will also be of imense advantage in times of excessive rain. The storage capacity of the soil is vastly increased, and the run-off in a heavy, rainy season thereby diminished. The result will be fewer and less disastrous floods, and moister, less hardened fields.

THE FALLING WATER LEVEL.

In this connection the late Dr. McGee has made interesting studies relating to the water line of the soils of this country. According to his investigations the water line of the soil is receding, that is, one has to dig further to find water now than he did fifty or one hundred years ago. This continued lowering of the water line is laid mainly to the deforestation of the country. If this be true, the water line may be raised again by reforestation of those denuded areas which are unsuitable for cultivation. Naturally the danger of a drought which will injure the crop is increased in proportion as the water line is lowered, thus rendering capillary moisture inaccessible to the growth of plants.

The farmer, therefore, who is able to afford it, should institute experiments looking to his greater independence of the vicissitudes of the season. It is well known that the amount and distribution of the rainfall is one of the dominant features in the variation of crop yields. Vast areas of our country are ruined agriculturally every year by persistent drought. This is particularly true of those States which border on the arid regions, as Texas, Oklahoma, Kansas, Nebraska and the Dakotas. There is scarcely a year that some very large area of this region is not practically rendered worthless by persistent drought.

It may be that the evils of deforestation have been somewhat accentuated, but I do believe that it is the universal experience of all persons who have lived in a wooded country that there is a greater uniformity in the moisture of the soils of the forest than ever has been noticed in the soils of the field. Whether or not Dr. McGee was right in supposing that there is a recession of the water line in the soil, makes little difference from a practical point of view. To restore pristine conditions by reforestation would mean the overturn of the work which our fathers did in clearing the fields of their forests. Moreover, the benefit which reforestation could offer would be an extremely slow one, and a great many years would have to elapse before it could bear its full fruition. On the other hand, the farmer may at once begin to prepare a deeper seed bed, and thus secure the same purpose in an entirely different way. Deep plowing, sub-soiling, and keeping the surface of the field in perfect tilth, in my opinion are the great forces which tend to nullify the effects of the unequal distribution of the rainfall.

XXIV

THE FUNCTION OF WATER IN AGRICULTURE

IN December, 1894, I accepted an invitation to address a convention of irrigation farmers at Fresno, California, on some matter connected with agriculture. It occurred to me that the most appropriate theme which I could discuss before such a convention was the function of water in agriculture. I therefore prepared an address in which I considered water in its various aspects relating to the farmer. I propose to give in a brief space some of the more important points covered in that address.

Few farmers realize the dominant influence of water as a factor in agriculture. When we look at agriculture from a strictly scientific point of view, without reference to its economy, the soil becomes a very secondary consideration. The skilled chemist can produce a synthetic soil from sand, carbonate of lime, salts of potash, artificial humus, nitric acid, phosphate of lime and other ingredients, in which plants will grow luxuriantly and to complete maturity. The farmer can also create a synthetic atmosphere, as is done in the building of the so-called hothouse. The farmer further can produce a synthetic precipitation by adding the water to the growing crop directly.

The creation of an artificial climate, however, over a large area is beyond the scope of human endeavor. On the contrary, a soil which is practically infertile,

EARLY EXPERIMENTS IN RECLAIMING SOIL
The whole surface was covered by a beautiful growth of young locusts

incapable of producing a crop, may be restored over wide areas to a condition of great fertility. In other words, it may be made to feed the growing plant. Thus while artificial climate, irrespective of water supply, must of necessity be confined to the narrowest areas, a soil may be practically reconstructed over large areas and economically utilized for the growing of crops.

In all places where irrigation is possible such soils may be made independent altogether of natural precipitation. The quantity of water required for a growing crop is enormous. We are familiar with the rapidity with which the hot sun can dry a field, but the quantity of water which the sun may take from the soil is by no means so great as that which is exuded from the foliage of the plant at the period of its most rapid growth. Computations of the quantities of water which are thus evaporated into the air from the leaves of plants are necessarily largely estimations. Enough is known, however, to make it certain that a rapidly growing crop at the period of its greatest exuberance is a much more potent factor in drying the soil than the sun's rays.

PLANT FOOD IN SOLUTION.

The plant food exists in a soil of ordinary content of moisture in a state of solution in the soil moisture. The particles of moisture are extremely small, but that doesn't prevent them from becoming saturated with the soluble materials of the soil if there are enough of them in the soil to produce this saturation. The droplet thus saturated is beyond the ken of the eye, but possibly might be seen with a powerful microscope. As the quantity of water in the soil diminishes, the quantity of plant food in solution is decreased. In other words, by evaporation of the particles of water the contents which they held in solution are solidified and deposited.

That soil is fertile in which there are sufficient quantities of plant foods to properly saturate the soil particles, and thus permit of the translation of the inorganic constituents of the particles of water to the living fluids of the plant and their elaboration into new forms of growth. The maximum fertility of the soil, other things being equal, will be found in such a distribution of the water content as to maintain always a normal saturation of the water particles with the soluble constituents of the soil. I mean by normal, that quantity which will afford the rootlets of the plant the maximum of food which they demand. In the growing crop, therefore, damage is produced whenever the quantity of soluble materials in the soil, due to the amount of water present, is too small, as in the case of drought, or too large, as in the case of flood, to properly nourish the plant.

We have this year seen a remarkable illustration of the mass action of seasonal factors in the production of a record-breaking crop. The data which are available at the time of this writing, end of June, 1914, seem to indicate the greatest yield of wheat, both in actual quantity and in amount per acre, that this country has ever known. This increased production cannot be in any way attributed to an increased fertility of the soil. In point of fact, as has before been pointed out, the soil fertility is probably decreasing as a whole, instead of increasing, in the country at large.

RESPECTIVE WEIGHTS OF WATER AND CROP.

The only other factor which can be considered is the season itself. That means the amount of rainfall, its distribution, the quantity of heat registered from the sun and its distribution, and the periods of low temperature and their distribution. Thus the bumper crop of wheat which we are now harvesting is due chiefly to seasonal influences over which the farmer has no control. Among these the water factor plays a dominant part. Water, therefore, is charged with a great agricultural duty. The failure of the water to perform its normal functions, either through a deficiency or an excess of supply, affects most profoundly the total yield. Thus among the factors of environment the most important to be considered is water itself.

Dr. McGee, shortly before his untimely death, published a most interesting article, in which he developed along many lines this idea of the agricultural duty of water. From Dr. McGee's paper we learn the percentages of water in various types of soil which are most favorable to crop production. The optimum of moisture ranges from 4 to 45 per cent., and in some vegetable soils the optimum percentage of moisture is even higher. If the depth of the soil under cultivation is represented by a foot, the quantity of water per acre to this depth should average about 2,000 tons. The average quantity of water required per acre for the production of a good crop is about 6,000 tons per year.

In general it may be said that under favorable conditions of the natural distribution of water, the weight of crop produced is about one one-thousandth of the amount of water used in its production. In other words, a pound of wheat and straw in natural proportions requires about one thousand pounds of water for its production. On the other hand, including the soil to a depth of one foot, under favorable conditions of moisture and other elements of the environment, a pound of soil produces about 1/333 of its weight of a crop. In other words, a pound of maize, grain, blade and stalk in natural proportions, would require about 333 pounds of soil for its production. We would hardly think in looking at a loaf of bread weighing one pound and a half that almost 1,000 pounds of rainfall and 333 pounds of soil were necessary for its production.

In general it is found that taking soils as a whole, the reduction of their water content to about 8 per cent. would practically inhibit plant growth. It is sometimes almost a marvel that a plant can live at all during periods of drought, when as far as the eye is concerned no trace of moisture can be detected in the first few inches of the soil of the field. It is not an unusual thing, however, to see a crop revived and again placed in vigorous growth after an abundant rain, which apparently was beyond hope before the rain descended.

In irrigated regions it has been possible to measure very accurately the amount of water necessary for the production of a crop, where the water is applied as wanted, great economics are secured, and these measurements confirm the statement above given. Measurements made in Idaho with various crops have shown the following ratio:

1 pound of alfalfa	requires 432	pounds of water.
1 pound of beans	requires 153	pounds of water.
1 pound of beets	requires 91	pounds of water.
1 pound of Indian corn	requires 136	pounds of water.
1 pound of oats	requires 91	pounds of water.
1 pound of potatoes	requires 46	pounds of water.
1 pound of wheat	requires 66	pounds of water.

Professor King found by measurements made in Wisconsin with a controlled water supply that, on an average, 446 pounds of water were required to produce a pound of dry crop. This is a little higher than the estimates made for the irrigated regions in Idaho. These data, however, are sufficient to show not only the dominating influence of water in crop production, but the enormous quantity of it required. They also show that where the precipitation is about equally distributed over the entire year with a rainfall of approximately 40 inches, only about one-third of the precipitation on a field of growing grain is used.

THE WEIGHT OF THE SOIL TO THE ACRE AND AVERAGE RAINFALL.

Very many determinations have been made of the specific gravity of the soil. When this is ascertained it is easy to calculate the weight of the soil per acre to any given depth. Ordinary soil is about 2½ times heavier than water, and the weight of soil, one foot deep, over an acre of land is approximately 2,000 tons. The amount of water, therefore, necessary to produce a crop is many times heavier than the weight of the soil to the depth of one foot in which the crop grows.

Over the so-called humid region of the United States the mean rainfall is about four feet. The mean rainfall over the States in the regions bordering the arid area of the United States is about thirty inches. The mean rainfall in the semi-arid regions of the United States is about twelve inches; while the mean rainfall for the driest portions of the United States varies from nothing at all to about six or seven inches.

Of the total amount of water that falls on the surface of the soil, about one-third reaches the sea. A small quantity of the water is worked up into organic union with growing crops, or in the crystallization of minerals, or else sinks so deep into the earth as to escape any further measurement. All the rest of the rainfall, except the two parts mentioned, is thrown back into the air by evaporation. In other words, considerably more than one-half of all the water that falls on the surface of the earth is returned to the air in gaseous form. It is the part of the water that runs off into the sea that produces the erosion of the soil, to which attention has already been called.

Often the expression is heard that the seasons are changing, that some portions of the country are becoming drier and some portions wetter. The data on which such assumptions are based are wholly untrustworthy, or at least too fragmentary to warrant any general credence. One of the reasons, which has been most frequently assigned for changing seasons in so far as rainfall is concerned, is the deforestation of the country, which has proceeded at such alarming strides in the past. On this point the scientific men are at variance. The greater majority of them believe that the cutting of the forest tends to excessive precipitation or excessive drought. In other words, without diminishing the total quantity of rain the distribution of it is greatly disturbed, so as to permit of the excesses just mentioned.

On the other hand, many scientific men who have investigated these points are of the opinion that there are not enough reliable data at hand to draw any positive inferences regarding changes of climate due to reforestation. Nevertheless I think it is the general belief, based upon observation and upon theoretical reasons, that the wooded country is more apt to have an even distribution of its water supply through the year than one which has been deforested. In this connection, however, it should not be forgotten that vast regions of the United States have not been in forest at all within the memory of recorded history, and the distribution of the rainfall in these treeless areas seems to be in no wise dependent upon the fact that they had no forests within their borders.

Apparently the escape of forest soil moisture into the air by evaporation is retarded. On the other hand vast quantities are given off from the foliage of the trees. The planting of trees on all areas not suited to the plow is to be encouraged. Fields that lend themselves readily to tillage had better be kept for that purpose.

XXV

THE DECREASING MEAT SUPPLY

ONE of the great problems which future scientific agriculture will be called upon to solve is the decreasing meat supply. There seems to be no question, so far as statistics are concerned, that the increase of the population in the United States is more rapid than the increase in the number of meat animals on the farms. This is especially true of beef cattle, and to a less extent is also true of swine and sheep.

There are two methods of attacking a problem of this kind: One is the adoption of a modified vegetarian diet; and second, the increase in the number of animals which supply meat. In my opinion the path of wisdom traverses both of these territories of nutrition. There is little question in my mind of the fact that well-to-do urban people eat too much meat. When we sit down to a fashionable dinner we not only have oysters and soup, but also fish, a roast, poultry or game, and usually patties of some kind containing meat, and in general a diet, the nutritive portions of which are furnished chiefly from animal sources.

DIMINISH THE MEAT DIET.

For dietetic reasons, and that means also for health reasons, the great variety of products of animal origin furnished at the ordinary well-to-do dinner should be restricted. Aside from milk, butter and eggs, which are not generally looked upon as animal diet and yet in fact are of that class, one kind of meat at a meal is quite sufficient. I might even go further than this and say one kind of meat at one meal a day. For instance, if eggs be provided for breakfast, and that is the meal at which they are usually eaten, no other meat product is advisable, unless it be a mere sliver of bacon for condimental purposes. The luncheon is best without any animal product at all except milk and butter or cheese. Luncheon, for one of sedentary employment, should be a light meal. The dinner, which should come after the day's work is over for all who are engaged in sedentary employment, may have a roast, beef or mutton or pork, or poultry or game, but never more than one.

If these ideas of dietary practice could be carried into effect, there would be a less demand for meat among the well-to-do. This diminution of demand, other things being equal, would produce a lowering of price which would enable those in more straitened circumstances to indulge in meat oftener than they do. From the selfish farmer's point of view the lowering of price is not desirable. I may say, even, that from the scientific point of view on the agricultural side, the lowering of the price to the consumer, which of course would have its reflex upon the price to the farmer, is not desirable, unless it could be effected by economies in handling the product.

LITTLE PROFIT IN BEEF GROWING.

My own experience during the present year 1914 shows that the price obtained by the farmer in the production of beef under present conditions is barely compensatory from a financial point of view. I sold, early in April, 35 steers, weighing at the barns an average of

1,165 pounds each. In shipment from my farm to Bennings, which is the abattoir of Washington, these animals lost 45 pounds each in weight, and I received for the weight at Bennings $7.75 per hundred pounds. Having kept a fairly accurate account of the expenses involved in producing these cattle, I found that, exclusive of the manure which they furnished, my actual profit on the transaction was a little over $100, or about $3 per head. It is readily seen that a very slight decrease in price of the cattle would have brought me out in debt.

Moreover, it is hardly probable that under present conditions the price of beef per head to the farmer would undergo very much diminution, unless it be by combinations in restraint of trade whereby the farmer will be frozen out while the consumer will still pay as much as he does at the present time. It is a noticeable fact that when the price of meat animals falls to the farmer, you wait a long time to see the price to the consumer diminished. On the other hand, when the price to the consumer is increased, it is a long while before the reflex of this increase shows in the increased profits of the farmer.

FORMER METHOD OF BEEF PRODUCTION ABNORMAL.

Up to the present time the production of meat animals, especially beef and mutton, has not been a normal industry. The vast areas of the semi-arid plains, which are open to free grazing, afforded an opportunity of producing beef and mutton under abnormal conditions, that is, under conditions of minimum cost. Animals produced in this way could be sold at a figure which rendered the efforts for the production of beef and mutton more generally throughout the older settled portions of the country a most hazardous business. There was no telling when the price to the producer of such animals would be so reduced by the heavy influx of plains-grazed cattle and sheep to the markets as to leave the old farmer on the wrong side of the balance sheet. These abnormal conditions are now rapidly disappearing. The grazing of the public domains has been reduced to a system, so that it is possible, with a fair degree of accuracy, to forecast the cost of production of meat animals of those areas. This gives a datum of substantial foundation to enable the older farmer who wishes to produce meat animals to determine, with a very great degree of probability, the amount of competition he will have to meet.

A study of the second problem, however, the increase in the number of meat animals, is naturally divided into two correlated parts. The growing of additional numbers of beef cattle will of course be accomplished just as soon as it appears to the farmer that he can get a greater profit by turning a bull calf into a steer to be sold at the age of two or three years for beef, than he can get by selling him at six weeks for veal, which is the common practice of to-day. Hence the increased production of beef animals must follow the conservation of the calf.

SELL OR KEEP THE BULL CALF.

Under the present practice a calf at six weeks will bring the Eastern farmer at least in the neighborhood of ten dollars in cash. If the calf is kept for three years and produces a steer that weighs approximately twelve hundred pounds, the farmer may expect a price, under present conditions, of from $80 to $100. Meanwhile, how much does it cost to maintain a steer for this length of time? In answering this question it must be supposed that the steer is fed and not starved, as is the common practice of farmers in so far as winter feeding is concerned. The young steer is put, his first winter, usually upon a diet of wheat straw and Indian corn fodder. The result of this diet is that he weighs less in the spring than he does in the fall, and has acquired the starvation habit, which is the natural result of his enforced hunger strike. It takes half of the next summer, when he is turned on grass, to overcome the handicap of the winter of starvation. Assuming that he has fairly good pasturage during the summer, that is all the feed he gets, and in the second winter he undergoes the same privations as in the first. In the third summer an attempt is made to prepare him for the market. As a rule, he gets nothing but grass. If this be blue grass and in abundance, it is all he needs; but it isn't every steer that has access to blue grass. In the autumn the farmer usually feeds him some freshly grown Indian corn to finish him, and in the beginning of October the steer grown in this way will weigh from nine hundred to eleven hundred pounds.

If the farmer had to hire the pasture and buy the straw and corn fodder and other food which is consumed during these three years and a half of life, he would have been feeding the animal for 1,277 days at 5 cents a day, which is a reasonable minimum of the cost of his food for this length of time. The total cost of the feeding of the animal is, in round numbers, $64. Add to this the cost of the invested funds and the risk cost of injury or death, and the result is, in round numbers, $75 as the cost of this animal. At 1,000 pounds at 7 cents a pound, he is worth $70, showing a net loss on the bringing up of this steer to a marketable state of $5. At 1,200 pounds this animal would show a profit of $9.00.

Contrast this with the selling of the calf at six weeks. The milk furnished by the mother of this calf may be roughly estimated at two gallons a day. The farmer can sell this milk in any ordinary market at about $.14 net per gallon. It therefore costs $.28 a day to nourish the calf. For 42 days the total cost of keeping the calf is $13.50. The calf should weigh 100 pounds, and it is worth $.09 a pound, giving a selling price of $9. The loss on the calf is only $4.

Thus it is a toss-up, under present conditions, whether the farmer should sell the calf at six weeks or keep him for three years and a half and sell him for beef. There is nothing in it for him in either case. The answer to this statement is that the calf on the farm, growing up a steer, eats food which the farmer could not sell. This is the whole story in so far as any profit is concerned. There is a certain amount of roughage and pasture on every well regulated farm that the farmer could not dispose of to profit, and hence it would be wasted if it were not fed in the manner described. Any profit, therefore, which the farmer gets from growing meat animals, is due to the fact that he may utilize food products which otherwise would be a total loss.

GROWING BABY BEEF.

In the scientific record of growing beef, namely, baby beef, can better results be obtained? In the first place baby beef, that is, animals not over 18 or 20 months of age, or two years at most, weighing from 900 to 1,100 pounds, bring a much higher price on the market than ordinary beef cattle. This increase of price amounts to from 1½ to 2 cents per pound on the hoof.

A baby beef weighing 900 pounds ought to bring the farmer $90. If the animal be sold at two years, he will have been fed for 730 days. From the beginning to the end of his life he eats about 17½ cents' worth a day. The total cost of production is therefore $127.75. The apparent loss on baby beef is $32.25 per head. The farmer, therefore, who had to buy all the food to bring up a baby beef steer, would be rapidly approaching bankruptcy. As in the other case, the salvation of this process is in the utilization of food which the farmer could not sell.

The above illustrations show the fundamental difficulty which has to be overcome before it is evident to the farmer that the production of increased numbers of beef cattle is desirable from his point of view. With the production of pork and mutton the difficulties are not so great, but not having had any very great deal of experience in this line I refrain from giving approximate estimates of cost and of profit or loss.

EXTENDING THE AREA OF PRODUCTION.

The second part of the problem is one more of theoretic consideration, namely, the more general diffusion of the production of meat animals. As has already been intimated, the vast plains of the semi-arid West and the fruitful cornfields of Missouri, Illinois, Indiana, Iowa and Nebraska, have been the dominant factors in the production of beef and pork. These great centers of production have been supplemented by great centers of distribution. After all has been said that is deserving, and this is much, of the advantages of great centers of distribution of meat products, it cannot be denied that there is always more or less danger of combinations, made possible by the existence of such centers, that are inimical to the producer on the one hand and the consumer on the other.

In other words, the practical control of the meat products trade by a few immensely wealthy corporations is an element of danger which cannot be too carefully considered. If the production of meat animals could be encouraged in all parts of the country, so that every farmer would have a few animals for sale, and if these animals could find a market in near-by centers, thus increasing immensely the numbers of centers of distribution, the dangers of the monopolistic system would be largely neutralized. It is highly important, therefore, that smaller centers of production be encouraged, and these, in turn, would make it possible to establish smaller centers of distribution.

HARDSHIPS OF TRUST CONTROL.

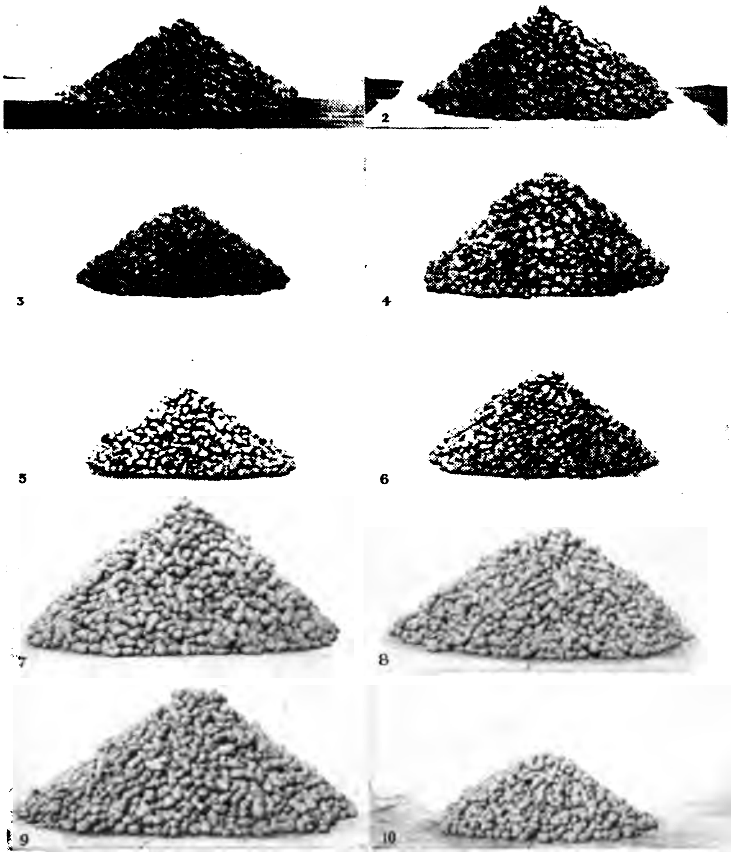
At the present time the farmer who produces a few steers, as is the case with myself, from fifty to one hundred per year, when he goes into the market meets the competition of the great distributing firms. Theoretically the price of cattle on the hoof in Virginia should be greater than in Chicago. This is true because the great majority of all meats consumed along the Eastern border of the United States come from the packing centers of the Middle West. Nevertheless, I believe it would be more profitable for the Virginia farmer, if he could ship in carload lots, to send his cattle to Chicago. There he would get from 1 to 2 cents a pound more on the hoof than he does at Bennings or Baltimore.

An illustration of this is found in my recent experience. My cattle lost 45 pounds a head in shipping from Bluemont to Bennings, a distance of 55 miles.

The cattle were 18 hours en route. The firm to which I sold them received, a short time afterwards, a carload of cattle from Chicago that had been three days and a half en route, and which had lost only 23 pounds per head in transit. It doesn't cost much more to ship a carload of cattle from Bluemont to Chicago than it does from Bluemont to Baltimore. The greatest degree of loss to cattle is during the first day of shipment. The next three days they would lose but little. Steers weighing 1,200 pounds in Chicago are worth from 8 to 10 cents a pound on the hoof. Could I have sold my steers, which ought to have reached Chicago weighing at least 1,100 pounds, at 9 cents a pound, I would have gotten $99 apiece for them; whereas I got only $85.50 a head for them at Bennings. In other words, I would have received, in round numbers, $11 apiece more for them in Chicago than I got at Bennings. This would have paid all the freights and left me still a handsome profit. Yet the very meat which we eat might have been sent back from these steers over the same line, as is the case every day, and thus have made a journey of nearly 2,000 miles before consumption.

NORMAL PRICE DISTURBED.

I have said that according to the natural law beef cattle on the hoof should be worth more along the Atlantic Coast, especially near the large cities of Baltimore and Washington, than they are in Chicago. As a further proof of this assertion I may say that the farmer gets more for his wheat and his corn along the Atlantic Coast, and especially near Washington and Baltimore, than he can get for it in Chicago. The average difference is about 5 or 6 cents a bushel. Wheat and corn are not controlled by any distributing corpora-



EXPERIMENTS WITH FERTILIZERS ON POTATOES, KENTUCKY EXPERIMENT STATION. POTASH IS ESPECIALLY USEFUL FOR POTATOES.

		Per Acre
No. 1	Blank	50.0 bushels
No. 2	Nitrate of Soda, 160 lbs.	60.5 bushels
No. 3	Acid phosphate, 140 lbs	43.8 bushels
No. 4	Muriate of potash, 160 lbs.	87.0 bushels
No. 5	Blank	45.0 bushels
No. 6	Nitrate of soda, 160 lbs.; acid phosphate, 140 lbs	59.3 bushels
No. 7	Nitrate of soda, 160 lbs.; muriate of potash, 160 lbs.	122.8 bushels
No. 8	Acid phosphate, 140 lbs.; muriate of potash, 160 lbs	95.0 bushels
No. 9	Nitrate of soda, 160 lbs.; acid phosphate, 140 lbs.; muriate of potash, 160 lbs	126.8 bushels
No. 10	Land plaster, 1,000 lbs	33.8 bushels

tion. They have a normal, natural price in the markets, and therefore the Virginia farmer gets more for his wheat or his corn than the Illinois farmer does, and this is in accordance with the legitimate principles of transportation, supply and demand.

DATA RELATING TO DECREASING MEAT SUPPLY.

The latest obtainable data in regard to the shortage of meat animals are those issued by the Department of Agriculture, in February, 1914. They are as follows:

SHORTAGE OF 18,259,000 MEAT ANIMALS IN THE UNITED STATES

The indicated total shortage of meat animals since the census of 1910 is nearly 9 beef cattle, 7 sheep and over 3 hogs for each 100 of the total estimated population of the United States in January, 1914, according to the estimates of the Department of Agriculture just published in the *Agricultural Outlook.* This means that it would take 18,259,000 more meat cattle, sheep and swine than the estimates show at present in this country, to give the present population the same meat supply that the census of 1910 showed to exist.

These estimates are based upon reports and estimates from the Department's field and State agents and county, township and special correspondents, who have reported on practically every county in the United States. The figures moreover have been compared with those of the census of 1910 and with the records of tax assessors in the various States as far as they are available. The Department therefore believes that these figures represent the best information obtainable on the numbers and values of live stock, including meat animals.

The estimates with regard to meat animals, that is, cattle other than milch cows, and sheep and swine, indicate a steady and fairly uniform decrease in the number of meat cattle and sheep and a slight increase in the number of swine. The figures of the present estimates compared with the census of 1910 are significant in showing the decrease in the number of meat animals especially in comparison with the increase in population.

ACTUAL DECREASE OF MEAT ANIMALS

	January, 1914 (estimated)	Census 1910	Total Decrease (D) or Increase (I)	Average annual decrease or increase
Beef Cattle	35,855,000	41,178,000	(D) 5,323,000 (12.9%)	(D) 1,330,000 (3.2%)
Sheep	49,719,000	52,448,000	(D) 2,729,000 (5.2%)	(D) 682,000 (1.3%)
Swine	58,933,000	58,186,000	(I) 747,000 (1.3%)	(I) 180,250 (0.3%)

Total meat animals, Census of 1910	151,812,000
Estimated number, January, 1914	144,507,000
Estimated decrease	7,305,000

The figures by years are as follows, those subsequent to 1910 being estimates of the Department of Agriculture:

	Beef Cattle	*Sheep*	*Swine*
January 1, 1914	35,855,000	49,719,000	58,933,000
January 1, 1913	36,030,000	51,482,000	61,178,000
January 1, 1912	37,260,000	52,362,000	65,410,000
January 1, 1911	39,679,000	53,633,000	65,620,000
Census, April 15, 1910	41,178,000	52,448,000	58,186,000

The actual figures of decrease or increase as stated above, however, do not take into consideration the increase in the population of the United States, and therefore do not show the difference in the ratios between meat animals and population as between January, 1914, and the census year of 1910. The report of the last census shows a population in 1910 of 91,972,000, and estimates an annual increase subsequent to 1910 that would make the population in 1914 equal to 98,646,000.

Taking this figure of estimated population:

Beef cattle are 19.2% short of the number necessary to maintain the per capita ratio of 1910, or	8,536,000 head;
Sheep are 11.6% short, or	6,509,000 head;
Swine are 5.2% short, or	3,214,000 head;
Making an indicated total shortage of meat animals since the census of 1910 of approximately	18,259,000 head

Notwithstanding the fact that the estimates show there is actually a decrease of 7,305,000 food animals since the census of 1910, the estimated farm value of the cattle, sheep and swine on farms on January 1, 1914, shows an increase, because of higher prices, as follows:

Estimated value, January, 1914	$1,930,087,000
Census (1910)	1,534,600,000
Increase in valuation	$ 395,487,000

The increase indicated is due to the fact that the estimates show that the farm value of beef cattle has increased from $19.07 to $31.13 a head, or 63.2%, an average annual increase of over 15%. Swine have increased in value from $9.17 to $10.40 per head, or 13.4%. Sheep have decreased from an estimated average farm value of $4.12 in 1910 to $4.04 in 1914.

FARMERS NOT PROFITING BY INCREASED VALUATION

This increase in the average value of meat animals, however, does not necessarily mean that farmers or stock raisers are making more, if any, profit. On the contrary, the cost of production has probably increased more rapidly than the increase in the selling price of live stock.

SOME CAUSES OF THE SHORTAGE OF MEAT ANIMALS AND INCREASE IN THEIR VALUE

The shortage of meat animals is probably due to a number of contributing causes. Some of the more important of these are:

The encroachment of farms upon the range territory.

The lack of a proper range leasing law permitting economical management and utilization of ranges.

The shortage in the corn and forage crop due to the severe drought in Kansas, Nebraska and Oklahoma in 1913, which caused the farmers in those States to dispose of their meat animals.

The increase in the value of land and the increased cost of labor and stock feed, resulting in greatly increased cost of production.

The decline in stockraising on farms in the East and South because of poor marketing facilities, resulting from many local slaughtering establishments having been driven out of business by the competition of the great central slaughtering establishments of the West and Central West.

The temptation to sell live stock at the prevailing high prices rather than to continue to carry them with high-priced stock feed, possible loss from disease or accident, and uncertain prices the following year.

NO LONGER PROFITABLE TO GROW MEAT ANIMALS.

From these data the officials of the Department of Agriculture conclude that even at the prevailing high prices it is no longer profitable for farmers to grow meat animals. In other words, the cost of food for these animals and the cost of taking care of them have increased at a more rapid rate than the price of the animals themselves when sold. It is generally conceded by farmers who have lands suitable for the ordinary purposes of agriculture, that it doesn't pay to grow beef cattle on the farm. It is more remunerative to purchase the cattle at the age of two or two and a half years from localities where grazing only is possible. Nearly all the farmers in Loudoun County, Virginia, grow beef cattle for the fall market, and practically all of them buy their cattle either from the West or from the mountains of southwestern Virginia, northwestern North Carolina, and eastern Kentucky or Tennessee. On these mountains, where plowing the fields is somewhat difficult and land is cheap, the steers may be grown without much artificial feeding and very little care, and perhaps at a profit to the farmers of those localities. These young steers at two and a half years of age cost the Loudoun County farmers about $45 apiece, and by keeping them over winter and turning them onto the blue grass the next summer, the farmer thinks he makes a large profit when he sells them for from $70 to $80 apiece.

I have tried in a small way to grow a few beef cattle, full-blooded and grade Aberdeen Angus variety. For these steers, when at 1,000 to 1,200 pounds, I am able to get half a cent a pound more than for the ordinary beef cattle. When, however, the cost of feeding these cattle is taken into consideration, and also the cost of care, the profits are not superior to, and perhaps hardly equal to, those obtained in the ordinary method of purchasing stock cattle which prevails in the community.

In regard to this lack of profit to farmers, the Department of Agriculture report referred to makes the following comment:

MEAT RAISING EVIDENTLY NOT PROFITABLE TO FARMERS

The large increase in the value of meat animals on farms is probably accounted for by the increased cost of production and the increased consumption or demand arising from the fact that production has not kept pace with the increase in population, and in the case of cattle and sheep has actually declined. It is well known that producers of farm products are the last to receive any benefit from higher prices paid by consumers, yet they are among the first to increase production if there is a prospect of realizing better returns. The very fact that there is a present shortage of nearly 19,000,000 meat animals in the United States since the census of 1910 indicates clearly that the business is not profitable to producers; otherwise every farmer and stock raiser in the country would have increased his herds of meat animals. It should also be borne in mind that the estimated average value of meat animals is their value on the farm, and not the wholesale or retail value. The farm value, or average price received on farms, is much less than the wholesale prices and considerably less than the retail prices to consumers.

Another distinction which is rather discouraging to the farmer who would like to grow his own beef, is this: When the farmer hands in his returns for his income tax and states the price he received for his beef cattle, he is allowed to subtract the price he paid for them as stock animals. On the contrary, if the farmer grows his own beef on the farm and sells the fat steer for $90, the whole selling price must be reported for income purposes.

These conditions indicate so grave a situation as to require the careful consideration of all who are interested in the future of agriculture. The old system of providing the meat supply of this country has broken down. When we had access to the almost unbounded wealth of the virgin soils of the Middle West and the grazing States, the cost of production of meat was reduced to a minimum. At the same time there arose in this country a method of handling meat animals in large packing houses. There is no question of the fact that the cost of handling in this way is reduced to a minimum. It costs far less to slaughter the meat animals in a large packing house and prepare them for consumption than it would cost the farmer who did it at home.

The meat supply of this country was therefore an abnormal one, due to the cheapness of production on the one hand, and to the efficiency and cheapness of handling on the other. But these benefits to the consumers during the last fifty years are hardly to be counted as blessings to the consumers of the next fifty years. The whole theory of meat production must be changed. The production of meat should become universal instead of localized. Every farmer ought to be able to produce a few meat animals more than is necessary for his own supply. The meat industry would thus be decentralized and spread over the whole country. The possibilities of manipulation which the monopoly of the business now offers would be minimized.

By this universal extension of the industry a multitude of small abattoirs, controlled by the towns and small cities, would arise, which, while they could not compete in absolute efficiency and economy in the handling of meat animals, would have the advantage of handling them near the points of consumption. We should not look forward to a period when the killing would be done on the farm; this is too wasteful and too cruel; but we could look forward with hope and enthusiasm to the establishment of the small abattoirs of which I have spoken. It has been my good fortune to see some of these small abattoirs under municipal control, and I have found them clean, sanitary and efficient. There is also a benefit to agriculture in having the abattoirs scattered all over the country. The offal, the blood, the tankage and the refuse of the abattoir make excellent fertilizers, and these could be produced in the localities where they are needed.

ENCOURAGE THE SMALL FARMER TO GROW MEAT ANIMALS.

Every effort it seems to me, therefore, should be put forward to encourage the small farmer to grow meat animals. If this is not done, the realization of the ideal of the local butcher of steak at $1 a pound may not be very remote.

On the other hand, meat animals controlled by a few immense corporations do not obey the usual law of demand and supply. The problem is a difficult one, but if meat animals are to be increased in proportion to the number of population, they must be grown by greater numbers of people and under conditions which eliminate unnatural control of price. The figures collected by the Bureau of Labor show that in many places the retail price of beef is, in round numbers, fifty per cent. higher than it was a few years ago to the consumer. And the retail price of pork has gone up at a still higher rate. The possible contingency of lowering the price of beef by importation from foreign countries is not one that appeals either to the patriotism or the pocket-books of the American farmer. As Henry Wallace, one of the deans of agricultural editorial writing in the United States, has very aptly remarked:

> It is not likely that the farmers would consider themselves particularly obliged to grow enough cattle irrespective of profits so as to keep the packing houses running at full capacity and thus enable the packers to make a maximum of profit.
>
> They have not yet forgotten 1908, when the banks of the West were full of packers' paper, which, it was claimed, did not exceed in value the meats in cold storage and could have been paid off by simply stopping the purchase of cattle for six weeks.
>
> What they did was to cut down their purchases for three months — and every man that had cattle or hogs to sell at that time had to take about two-thirds of their value until the debts of the packers were paid. Many of the farmers still remember this and will not soon forget it.

XXVI

STATISTICS RELATING TO ANIMALS ON FARMS

THE number of cattle, excluding calves, on farms in the United States for the census years 1910, 1900, 1890, and 1880, is given in the table below; also for the years 1910 and 1900, the number including calves:

NUMBER OF CATTLE, EXCLUDING CALVES, ON FARMS

1910	1900	1890	1880
53,997,327	52,403,828	57,648,792	39,675,553
* 61,803,866	67,719,410		

In regard to these comparative numbers, it is stated in the census report that the enumeration for the thirteenth census was made as of April 15th, while the enumeration for the twelfth census, 1900, was as of June 1st. It is therefore concluded that some five or six million calves which were born between the period of April 15th and June 1st were not enumerated in the census of 1910. Thus the total number of cattle for comparative purposes in the 1910 census should be increased by five or six million in order to be comparable with the census for 1900.

Allowing for the number of cattle which would have been slaughtered or died during this interval, also, the census concludes that instead of a decrease in the total number of cattle of 8.7 per cent., as shown by the

* Including calves.

census figures, there would probably have been a decrease of not more than three million, and possibly not over one million, had enumeration for 1910 been made as of June 1st. Even this small decrease in the number of cattle is significant, however, when considered with the increase of the population of the country during the decade.

Thus it is seen that, so far as the official figures for 1910 are concerned, there was a notable decrease of cattle on the farms during the decade and a very large increase in the population. The number of cattle on the farms was very much less in proportion to the population in 1910 than it was in 1900. It is also reasonable to suppose that this discrepancy has increased during the four years that have elapsed since the enumeration of the thirteenth census was made.

It is interesting to compare these data with the number of domestic animals in Great Britain, as reported in *Publications of the International Agricultural Institute,* Volume III, No. 11:

NUMBER OF LIVE STOCK ON JUNE 4, 1913, COMPARED WITH THE NUMBER ON JUNE 4, 1912.

Class	1913 June 4th.	1912 June 4th.	Decrease	(1912 = 100). %
Horses	1,402,146	1,406,610	3,864	0.3
Cattle	5,716,944	5,841,720	124,776	2.1
Sheep	17,130,286	18,053,365	923,079	5.1
Swine	2,101,902	2,498,670	394,768	15.8

NUMBER OF DAIRY COWS IN THE UNITED STATES.

The number of dairy cows for the four decades from 1880 to 1910, inclusive, is as follows:

1910	1900	1890	1880
20,625,432	17,135,633	16,511,950	12,443,120

In regard to the dairy cows, the census reports that there was a nominal increase over the number for the twelfth census of 20.4 per cent. The animals designated as dairy cows, however, at the census of 1910 included all born prior to June 1, 1909, or, in other words, all over fifteen and a half months old; while the class designated as dairy cows in 1900 included only those two years of age or over on June 1, 1900.

While the data of comparison are therefore not strictly representative, the census report concludes that after making all necessary allowances in the different methods of enumeration, there was a very considerable increase in the number of dairy cows between 1900 and 1910. The dairy industry therefore is increasing in the number of dairy cows, and doubtless also in their quality. Its growth is less rapid than that of the population; while, on the other hand, the business of raising cattle for slaughter is rapidly declining.

The tendency to decrease the number of farm animals appears to obtain in Great Britain also.

ANIMAL FOOD PRODUCTS.

In regard to the food products of domestic cattle, interesting data are supplied by the census. The total quantity of milk reported as produced on farms for the census year 1910 was 5,813,699,000 gallons. The average production of milk per cow was about 362 gallons. The total reports, however, cover only a little over 16,000,000 cows. If the unreported milk of the remaining cows should be added to this quantity, it is seen that the total production on farms in 1909 would have been about 7,466,406,000 gallons. For 1899 the estimated quantity of milk produced was 7,265,804,304 gallons. The average amount per cow for 1910 was 362 gallons and for 1900, 424 gallons. The average value per cow of the milk produced in 1900 was $27.56, and in 1910, $31.82. These values per cow, however, do not include the amount of milk and other dairy products consumed on the farm.

The Director of the Census, in discussing the data, calls attention to the fact that while the figures apparently show a larger production per cow in 1900 than in 1910, this does not warrant the belief that there has been an actual decrease in the average production of milk per dairy cow. The figures for 1910 are believed to be more accurate than those for 1900, for in these latter is included a large element of estimations.

In regard to the quantity of butter, is included not only the butter made on farms, but also in factories. The totals for the United States for the census years 1900 and 1910 are as follows: 1900, 1,491,752,602 pounds; 1910, 1,619,415,263 pounds — an increase of 8.6 per cent. in the total amount of butter made as compared to an increase of 21 per cent. in the population. The quantity of cheese produced, both on farms and in factories, for the two census years is as follows: 1900, 298,314,642 pounds; 1910, 320,532,181 pounds — an increase of 7.4 per cent. Since the data summarized above have been collected a phenomenal increase in the value of dairy cows has taken place. Good grade cows of the leading types, viz., Holstein, Jersey, and Guernsey, sell at auction at from $75 to $100, while registered animals cost very much more. The movement to exterminate tuberculosis in milch cows is gathering momentum and I hope will soon be completely successful. Various estimates of the number of tuberculous cows have been made on the basis of the number reacting to the tuberculin tests. These estimates indicate that a larger percentage, possibly 25 per cent., of the dairy cows in the country will be slaughtered in the campaign of exterminating this threatening disease. The near future for this reason will see a still greater increase in the value of sound cows.

XXVII

THE TRUE RELATION OF SCIENCE TO THE INDUSTRIES AND ARTS

Proceedings of a Convention of Agriculturists held at The Department of Agriculture, January 23, 24, 25, 26, 27 and 29, 1883. (Second Convention.) Special Report No. 2.

The evolution of Agricultural Science has been phenomenal in the past third of a century. The point of view as far back as that may show at least how far we have come. The following paper was read before a meeting of representatives of the Agricultural Colleges and Experiment Stations, Boards of Agriculture and Agricultural Societies, held in Washington, on invitation of Commissioner of Agriculture George B. Loring, January, 1883. This convention was the precursor of the Association of Agricultural Colleges and Experiment Stations, which now exerts a powerful favoring influence on agricultural education in the United States.

Some of the prophecies of thirty-one years ago have already been fulfilled. The transfer of the weather predictions from the Signal Service has long been an accomplished fact. The weather service was given to the Department of Agriculture as I predicted. The work of the agricultural colleges and experiment stations has been systematized and vastly improved. Trained experts, not available thirty years ago, are now in control of most of the experimental work. Technical instruction has advanced so rapidly that no longer does a young American need to go abroad to obtain the technique to do his work. Large numbers of students are devoting themselves to agricultural studies and pursuits. Engineers of all kinds, civil, mechanical, electrical and agricultural, are graduated in increasingly large numbers from Uncle Sam's big university. The impress of this flood of technical education is felt in every industry. Unfortunately, agricultural industries have received, so far, the least assistance. But this is changing. The graduate of the agricultural course is beginning to find himself. As foreman of the farm or director of the dairy, he is putting into practice the principles of economy and efficiency so greatly needed in the field and orchard.

In writing of variation and crossing thirty-one years ago I could not have mentioned the name of Luther Burbank. His star, of the first magnitude, had not yet risen. As I look back a third of a century and see myself writing these lines, I cannot repress a feeling of exultation at finding things as good as they are. We have come farther than I imagined possible in January, 1883.

SCIENCE is the mother of the industries and arts. I propose in this essay to set forth this maternal relation and briefly illustrate its conditions. An industry or an art is applied science. This science is sometimes the result of theory, but more often the offspring of experience. Science is knowledge of matter and the laws which its action reveals. Every industry and every art is directly dependent for its success on knowledge of the matter worked upon and the laws of its existence. To know something of the nature of ores and of metals is indispensable to even the crudest forms of metallurgy. Tubal Cain had first to devote himself to science before he could become a worker in brass. Blot out of existence what science has revealed of the nature of metals, and the progress of the world would at once be stopped, and all civilized nations relapse into barbarism. A beautiful illustration of the relation of science to the arts is found in the manufacture of steel. Chemistry revealed the fact that steel differed from wrought iron mainly in its content of carbon.

The chemist also learned that cast iron is richer in carbon than either steel or wrought iron. In the process of puddling, the extra content of carbon in cast iron is gradually burned out. This led the chemist to believe that if this combustion could be stopped at the right time the manufacture of steel could be rendered much cheaper. This idea eventually took shape in the Bessemer converter. As a result, every industry and every art has been immensely benefited. All tools for the machinist, the carpenter's planes, the farmer's plows, have felt the influence of this discovery. It has netted the continents with steel rails, and thus cemented the ties of international friendship. It has made steel-plated ships in place of the oak hulls of our fathers, and has profoundly affected the progress and wealth of the world. Cheap steel means plenty of work, good wages, and cheap bread.

Cheap steel is a great civilizer and a great missionary. The most bigoted heathen idolator, who remains unmoved by the sincerest and most potent appeals of the devout missionary, would not endure for a year the exhortations of a Bessemer converter. If science had never done anything for the world other than making cheap steel a reality the world would be to science a hopeless debtor. What is true of the steel industry is true of every metallurgical process. We are apt to forget in the ripeness and success of a business how it arose and by what fostering care it was protected.

In this day, however, when most of the industries and arts have already advanced to a fair degree of perfection, we are not practically interested in how they had their origin. This is a question more of historical than of practical interest. Science however has not lost its vital relation to industry by this advancement. Having been the source from which the industry sprang, it remains the protector and promoter of industry. He is filled with a false and dangerous pride who maintains that any science or art has attained its perfect development. In such self-satisfaction are always found the roots of decay. True, much has been accomplished, but much yet remains to be done. We may then propose as the chief theme of this essay, "Science, the guardian of industry and art." And, first: What are some of the ways in which this guardian care is to be exercised? First, I will answer, science must furnish an educated body of workmen. Industrial education is the first great duty of the State. Congress never enacted a wiser law than that which set apart a certain portion of the public domain for the purpose of encouraging agricultural land, technical education in the various States.

It would be out of place here to criticize the disposition which has been made of this munificent gift. It would be easy to point out blunders and mistakes. Blunders arising from lack of judgment and mistakes arising from ignorance. What is to be considered now is the intention of this grant. And this certainly was of the best. The great demand of our country, rich in reality, rich a thousand times in near possibilities, is educated craftsmen. In our eagerness to get wealth, in the wild exuberance of our growth we have neglected too much the demands which the near future will have upon us. Our fields will not always be fertile without fertilizers; gold will not always be found in the river sands, to be had for the collecting; we cannot always look to Europe for the finest works of skill. This country is too large, its wants too gigantic, to be supplied by foreign hands.

Science therefore comes forward and offers her help in giving to the youth of the land a technical education.

The education which science offers is not of the brain alone. There is no dearth here of lawyers, and doctors, and preachers, and novelists, but science recognizes the fact that a human being has a spinal cord as well as a cerebrum. Backbone is the watchword of technical education.

Heine, in that beautiful and satirical poem entitled "Deutschland," speaks of the shadow that seemed to follow him one night through the streets of Cologne. It dogged his steps like a *spiritus familiaris*. At last he stopped and addressed it:

> I could not bear it, so turn'd sharp round,
> And said, "I insist on an answer;
> Why follow me thus in the silent night,
> And lead me this wandering dance, Sir?"
>
> The other replied in a somewhat dry tone,
> If not a little phlegmatic,
> "I pray thee, exorcise me not,
> And be not quite so emphatic!"
>
> "I am of a practical nature in fact,
> And of silent resolution;
> But know, that whatever thy spirit conceives,
> "I put into execution."
>
> "Thy lictor am I, and follow behind,
> And carry in all its splendor
> The polish'd executioner's ax;
> I'm the deed which thy thoughts engender."

So the spinal cord is the "deed" of the brain's thoughts.

EDUCATING THE BACKBONE.

All work of skill, all cunning and delicacy of handicraft are the results of educating the spinal cord. The anatomist will tell you that all the nerves that control or rather direct motion spring from this sensory center. And herein lies the great hold which true science has on every industry. True scientific study has always something for the hand as well as for the brain. Science without the laboratory, is a ship without a sea. In the study of botany we find the hand at once engaged. The manipulations of the magnifying glass and of the dissecting implements teach at once a skill and dexterity which are never without their value. The chemical and physical laboratory is even richer in culture for the backbone. No student can earnestly pursue the study of these sciences in a proper way without securing a technical training that will prove a lasting benefit. Men must produce as well as consume. Mere abstract reasoning is a good thing, but men cannot live on abstract reasons. Even turnips are more nutritious than abstract reasons. Fairies can "live on lovers' sighs," but shepherds and lord chancellors must have something more substantial. Science study, in order to have its true technical value, must be pursued in a scientific manner. What has caused science to be looked on with so much suspicion by many practical men? I answer, humbug. Much of what has passed for science in this and other countries has been the flimsiest shoddy.

In many places of instruction the object seems to have been simply "cram." Dead and dry platitudes have been forced down the throats of unwilling subjects to absolute nausea. So-called science has been taught without a single idea of what real science is. What, then, could you expect in the way of results? Nothing; absolutely nothing but disgust and distrust for everything which was suspected of being scientific.

Such science as this has no relation whatever to any art or any industry. Even agriculture has not been free from these pretenders and their nostrums, and it has been pelted and pestered in the name of science with so much that is irrelevant and nonsensical that no wonder is to be expressed at the hearty disgust which it has so often manifested. But happily, these doleful days are passing away and the dawn of the era of true technical training is dispelling the darkness which has kept scientific claims from appearing in their true light.

TECHNICAL TRAINING FUNDAMENTAL.

There is no art or industry which is not vitally interested in this technical training. In this training, I am sorry to say, we are far behind Europe. If we go into any of our factories where work of skill is required it is surprising to find how large a percentage of the workmen are of foreign birth.

Every true friend, therefore, of the industries and arts of our country must look with especial favor on the efforts that have been making during the past few years to build up in our country a vast and thorough system of technical training. Some may be disposed to complain because this system has so far yielded no striking results. But this is not just. The most valuable products are not taken from things immature. Time must be given for growth before demands are made for production.

In agriculture, the great and overshadowing industry of this land, how few are taking advantage of the scientific education which nearly every State offers her citizens! In one great State of two million inhabitants, a State with fertile soil and a favoring climate, not fifty young men are pursuing the thorough course

HON. G. B. LORING
Commissioner of Agriculture who called the first official convention of the Agricultural Colleges and experiment stations in 1883

in experimental and practical agricultural work which the State and country have provided.

THE DIGNITY OF LABOR.

Manual labor is the source of all wealth and happiness. No man fully measures up to the full stature of manhood who shirks it altogether. To labor with the hands is as honorable as it is necessary to human existence. Science encourages this habit of manual labor, and at the same time directs it to the best and most profitable results. Considered in all its aspects, therefore, we must allow to science the possession of a most intimate relation to all that pertains to real industrial and artistic achievements. Most certainly must we admit that, as society is at present arranged, it would be quite impossible that every artisan should receive a thorough scientific education. Most boys and girls are financially debarred from this. The eternal and insistent cry of the stomach is the first business which every person must attend to. When this is accomplished, in most cases, there is no time or opportunity for anything else. I have no Utopian view of universal technical education to offer here to-day. In these matters I am neither pessimist nor optimist, and only an agnostic by necessity. But if the cold facts of existence must make ninety-nine shiver through life let the one be warm, and be able to devise means whereby the ninety-nine may shiver less. One thoroughly educated artisan will prove an inestimable blessing to a community of uneducated artisans. And so it happens that, while science works apparently only for the few, in reality it is the many who reap the great benefit. Unhappily the forces of Evil are more keen than those of Good to apply the discoveries of science. Peace is not served as well as war.

THE CONTRIBUTIONS OF CHEMISTRY.

Perhaps it would be well to illustrate by a few instances how scientific training and scientific methods have proved beneficial to an industry, and I do not know of any more striking example than that great industry in whose interest we are here to-day. I will cite first what chemistry has done in working up the refuse of civilized life into useful products. One or two instances of this will be sufficient. Take the case of bones. Chemistry has shown that bones contain a large amount of phosphoric acid. It also showed that this acid was an essential constituent of plant life, especially of the cereals. This was the beginning of a great industry. Bones which before had been the pest and plague of cities and towns were carefully collected, ground and returned to the soil as a most valuable fertilizer.

Chemistry also showed that the nitrogen of plants was not taken from the nitrogen of the air, at least only in small quantities by one family of plants. On the other hand, it appeared that nitrogen in the form of ammonia was most readily absorbed. This led the way to the guano beds and the cess-pools. What was before considered not only worthless but really noxious, was now sought after to enrich the soil. It was also discovered that plants did not assimilate organic particles as such, but that all these had first to undergo decomposition before they could be used as plant food. This fact reconciled people to using as food, plants grown with fertilizers that were most offensive to thought and sense.

You may macerate a growing potato in starch, it will not absorb a single grain of it. You may soak the growing cane in sugar, the juice will not be one whit the sweeter. You may pour linseed oil around the roots of growing flax, the seed will yield no more oil under the hydraulic press than before. In all the above cases it is of course understood that the yield will be no greater than if an equivalent amount of inorganic matter had been supplied instead of the organic.

MAKING A GARDEN OF A SAND BED.

A striking case is found in the gardens of Asnieres, near Paris. These gardens, which now exhibit the luxuriance of the tropics, a few years ago were worthless fields of sand. Science has converted them to their present beautiful state. It has done this by bringing to them the poisonous sewage of Paris. Here, if anywhere, the plant will find opportunity to absorb these filthy organic matters.

But the vegetables and fruits produced here are as free from sewage taint as if they had been grown on the virgin soil of a Western prairie.

Here we see hundreds of acres covered with splendid vegetables and luscious fruits, which only yesterday were expanses of yellow sand, on which a few struggling weeds eked out a miserable existence.

In this manner, by the triumphs of science, the seeds of disease and the breath of pestilence have been made to bring forth health and wealth, and an arid waste has been transformed into a blooming field.

There, by the eye of scientific faith, in the blushing raspberry we see a metamorphosis of cholera infantum, now become a preserver instead of a destroyer of the children.

Deadly fevers appear, divested of all their terrors, in bulbous cabbages and pendent beans; miasma is seen quivering in the leaves of the apple and the pear, or secretly instilling its jaundice into the velvety coat of the peach; devastating cholera, green and glaring, writhes and wriggles in harmless rage through the vines of the cucumber, or loses in the prickly surface of the gooseberry its sting of death.

Chemistry is scarcely less valuable as a scavenger than as an inventor. In all the industries what to do with the waste product, is a question of no less importance than the value of the chief product. In the meat-making industries this economy of science is set forth in a strong light. No part of the animal tissue is now thrown away, where a few years ago there was an enormous waste. The hair, the hide, the vital organs, the hoof, the horn, the blood, and the bones have all found a valuable application. This saving of science has come upon us so gradually that we are not aware of its value. One pork-packing house in Chicago has lately said that it saved annually in waste products $200,000, which were lost twenty-five years ago. With such a fact as that on record, only the veriest infidel could doubt the economic value of science. In the economy of nature there is no waste. I will say but little more of the relation of chemistry to science. This theme has been often and thoroughly discussed. Returning from this digression, I will illustrate a little further what science is doing in the industry of agriculture.

LIEBIG, THE FATHER OF AGRICULTURAL CHEMISTRY.

Munich is happy in the possession of magnificent museums of painting and sculpture. The Glyptothek is a vast marble place; in style, resembling the temples of ancient Greece. This majestic hall is filled with the masterpieces of sculpture, gathered by skilled hands from all quarters of the globe.

We find there statues of Egyptian priests chiseled one thousand four hundred years before Christ; we find marble vessels used for holding the entrails of animals sacrificed by the earlier Pharaohs.

In the hall of Apollo we see on the one hand a colossal bust of Bacchus, the god of the vintage, and on the other a beautiful torso of Diana, the virgin huntress. One wanders from hall to hall, bewildered by the prolixity of art, and oppressed with the presence of antiquity.

In the old and new Pinakotheks is found even a greater degree of excellence in painting, and also a more lavish display of abundance than the Glyptothek has shown in sculpture.

The masterpieces of Holbein, of Claude Lorraine, of Rubens and Michael Angelo decorate every wall, and fringe the triumphs of skill with the halo of genius. Without, in the city, long streets bordered with bronze statues and ending in triumphal arches, lure the visitor on to admire their beauties and recall their histories.

Everywhere are Frenchmen, Englishmen, Americans, who have been attracted by all these wonders of art and have come, some to take a passing glance at them and others to study them more at their leisure.

But there is one place in Munich rarely visited by travelers. That place is found with some difficulty, and one enters a narrow and muddy court and finds his way into a dingy and dirty room. This room is ornamented with no chiseled marble, nor are its walls frescoed by the hand of old masters. The windows are small and low, and the plaster yellow with age and smoke. Yet this humble room has seen greater triumphs than any of those which adorn the galleries of art, or are celebrated in the monuments of the streets.

It has seen triumphs of toil and of genius which have not merely made one man famous, but have also made millions comfortable and happy. It has seen triumphs which have not filled long trenches with the dead and huge hospitals with the wounded, but triumphs which have made fields of peace fertile, and filled granaries to the top.

It is the laboratory of Justus von Liebig, the founder of agricultural chemistry, the benefactor of his age. Liebig himself is dead, but I seem to stand in the presence of his great genius, and to feel the inspiration of his wonderful industry and application. There is no other one place in the world which illustrates so convincingly the intimate relation existing between practical science and rational agriculture.

The work so splendidly begun by Liebig has not been allowed to languish with his death. Problems which he left unfinished have since been solved and new questions have been asked, which are now answering from a hundred experimental stations. Chemistry has the same vital relation to agriculture that anatomy and physiology have to medicine. The alleged surgeon who does not know the locality of the heart is no more at sea in his practice than the farmer who does not have at least a practical knowledge of the nature of soils, fertilizers, and crops. Ignorance of these things is not bliss, it is crime.

METEOROLOGY.

Another intimate relation of science to agricultural industry is found in the science of the weather.

Next to the soil, climate and the weather are the most important factors which enter into the agricultural problem. The science which studies these phenomena, discloses the laws which govern them, and foretells their occurrence, is called meteorology. The weather not only makes crops, but it may also ruin them. To be able to know the state of the weather forty-eight, or even twenty-four, hours in advance would save many a dollar annually to every farmer. It is true that an ancient writer has said, "In the morning sow thy seed, and in the evening withhold not thy hand." But we must remember this was written before the days of the signal service and modern science. The farmer, warned of an approaching storm, would not cut down six acres of grass in the morning to have it soaked with rain in the afternoon. With forty-eight hours' warning he could complete the planting of a field before the rain, instead of having to leave off in the middle of the work and then leave the other half without the benefit of the rain. With such a warning he could secure a field of ripened wheat and save it from being prostrated by the wind or torn in shreds by the hail. In fact there is scarcely a farm process that would not be better done or more timely done could the state of the weather be known in advance. The ancients fully realized the importance of this matter. That agricultural poet, Virgil, thus advised the Roman farmers: "But before we cut up the unknown plain with the plow, let us be careful to foretell the winds and the varied manner of the weather."

As in ancient times so still do we gain a good idea of the coming weather by observing the moon and sun, wind and cloud. Farmers now as then "pray for moist summers and dry winters. Corn is made joyous and the field glad in the wintry dust." A circle round the sun "betokens a great storm for farmers and for the sea." Before sunrise rays shooting up through the clouds indicate hail. "If the sun is spotted on rising or especially if half his disc be hidden by a cloud, a showery day may be expected."

"An azure color of the sky at sunset threatens rain." "A spotted sunset warns of storms." "If the sun both rise and set clear you need not be frightened by clouds during the day." Such are some of the indications which Virgil tells us were derived from the sun.

Respecting the moon, we learn from the same author that a red color of the moon indicates wind.

If the new moon rose and set clear on the fourth day all that month would be pleasant and free from rain.

It is easy to see that many of the signs of the weather which were relied on two thousand years ago are still considered valid at the present day. We are still able to judge by the sun, the wind, the cloud, and the rainbow, while all of you have heard the weather-wise predict the weather for the month from the appearance of the new moon about the fourth day, just as was done so long ago. We must remember, however, that it is still now, as it was then, somewhat uncertain to prophesy from these phenomena, either singly or collectively; and especially is it likely that "all signs will fail in dry weather."

Quite in contrast with the interest exhibited by the Romans in this matter was the apathy which prevailed no more than forty years ago. Speaking of this topic and that time, Liebig says: "No attention was paid to the latitude of the place, its height above the sea, the yearly mean of rain-fall, the rain-fall of different seasons of the year, the respective number of fair and cloudy days, the mean temperature of the year and of the different seasons, the extremes of temperature; no

TESTING THE SIZE OF THE OATS
"My first oat crop averaging 57 bushels per acre"

THE OLD FARM-HOUSE
"I found no sanitary conveniences for man or beast"

regard was had for the physical, chemical, and geognostic properties of the soil."

GROWTH OF WEATHER OBSERVATION.

Since the time spoken of by Liebig, however, a revolution has taken place in respect of these things. Every civilized Government has instituted a thorough system of meteorological observations taken at different stations and representing the mean of the whole country. These observations, it is true, were first undertaken for the benefit of commerce, but they are far more likely in the end to prove a greater benefit to farmers. As a result of this, agricultural stations generally have undertaken a similar series of observations, whose data can be added to those of the Signal Service proper. And here I will say with as much emphasis as plain statement can imply, that I regard the predictions of the so-called weather prophets as too preposterous to merit contradiction. And yet these vagaries of monomaniacs receive a quite general credence. People might just as well pin their meteorological faith to the predictions of the Patent Medicine Almanac. But it is quite different with a scientifically conducted signal service. The area of low pressure ascertained from the various parts of the country shows the direction of the winds. The telegraph also shows in what direction these areas are moving, and the anemometer tells the rate of their progress. These data, in connection with the temperature, the season of the year, and the degree of saturation of the air furnished by the hygrometer, give almost absolute data for predicting the kind of weather, when no unheralded conditions serve to change probable environment.

TRANSFER OF WEATHER OBSERVATIONS FROM THE SIGNAL SERVICE.

We should remember, too, that the Signal Service is still in its infancy, and that the maximum of scientific skill has by no means been reached in the interpretation of its data. But in spite of its infancy and consequent lack of perfection, its predictions are already quite reliable and receive everywhere a due amount of credence.

It is true, also, that storms which are vast in extent can be more certainly and sooner predicted than those merely local. But with the increase of signal stations even the latter will be foretold with almost absolute certainty.

Then the next difficulty which science has to remove will be the one connected with the distribution of these indications among farming communities. The merchant in the city, at breakfast, glances at the indications in his morning paper, and, in accordance with their predictions, either takes his umbrella to his office with him or else leaves it at home. But the farmer in the country has not this opportunity of deciding whether to cut his field of clover or not in the morning, with the expectation of getting the product under cover before night. This is not a proper place to discuss the means by which this information is to be conveyed. It could be easily done by the telephone and fourth of July flagstaff. Danger signals of an approaching storm could easily be placed so that they could be seen by every farmer before beginning his day's work. Or instead of the flagstaff, signal guns might be employed, and gunpowder and cannon thus be trained to serve the arts of peace instead of the furies of war. It will be enough to affirm now that whenever the Government sees fit to go to even a moderate outlay, science stands ready to put every farmer in the country *en rapport* with the Signal Office in Washington.

And since it thus appears that the Signal Service is chiefly for the benefit of that industry which raises our crops, and the one that carries them beyond the sea, cannot one pardon a suspicion that the Signal Service might do better under the peaceful flag of the Department of Agriculture than beneath the red and raging banner of the War Office? But this is a thought which must only be whispered in desert places, in tones as tremulous as the timidity with which it is now suggested.

BIOLOGY.

That part of biology which I shall mention as peculiarly beneficial to agriculture has reference to the study of domesticated and useful animals and plants, and the laws of their variation and improvement. I am aware that this theme, in a strictly etymological sense, does not fall under the head of agriculture; but, by immemorial usage, it has become a part of agriculture, since every farmer makes use of animals in doing the work of his farm, and is also, to a greater or less extent, a keeper of herds and flocks. Whatever, therefore, tends to improve the character or quality of his domesticated animals proves of immediate or ultimate advantage to the farmer.

In this way the science of biology in its special branches of variation, heredity, and natural and intentional selection has been of the greatest benefit to agriculture. As with the other sciences, so with this, we believe that the good which it has already done is but a beginning of what it will eventually accomplish.

INFLUENCE OF HEREDITY.

Science has shown that every species, and in fact every variety, has an inherent power of variability. It thus happens that the individuals of the same species or race, while they have a close resemblance to one another, are not exactly alike. Even the offspring of the same parents, when subjected to the same conditions of existence, as in the case of twins or polygenesis, are easily distinguished from each other. This variation from the type may be greater or less; usually it is very slight. Sometimes it is so great that it is called a monstrosity. By crossing different species, to produce hybrids, as in the case of mules and hinnies, a progeny is produced in which the variation from the parent forms is more marked. Hybrids often seem to possess characters which are almost a mean of those possessed by their parents, while often, also, by a certain prepotency of generative force in one or the other of the progenitors, the hybrid is attracted to one or the other of the species from which it is produced. But this variability in animals would prove of little use to man were it not for another principle, the law of heredity, which science has also discovered and formulated. While it is true that the offspring varies more or less from the parent, it is equally true and equally as important that there is also a greater or less resemblance between them. From this it happens that there is always a tendency for the parent to transmit to the offspring those peculiarities which are its distinguishing marks. Let us combine now with the two foregoing principles, viz., variability and heredity, that of selection, and we have the basis of the improvements of breeds, upon which every scientific farmer acts. Science, in the last few years, has, as thoroughly as time and opportunity have permitted, investigated the phenomena of variability, heredity, and selection, and as a result the practical man has now at his disposal a vast array of facts, which, a few years ago, were wholly unknown to him.

IMPORTANCE OF VARIATION.

Many of the causes of variation have been discovered. Chief among these known causes are climate and conditions of life. Thus meteorology again comes into play as an important factor in practical agriculture. Others are still unknown, but we do not despair of the discovery of many of these. Heredity is a natural principle so well known that we are astonished only when it fails to act. But science has done much to sort out and arrange the facts connected with its phenomena, although its laws have not yet been formulated. Science has shown that selection is a universal principle, and that it is of two kinds, natural and conscious, though it is not implied by this classification that conscious selection is unnatural. A good general example of conscious selection is the well-known fact that breeders generally keep the finest animals for breeding purposes, and thus keep their animals up to a high degree of perfection. In this way science, consciously or unconsciously, continually improves the condition of animals.

A few examples, illustrating the topic under consideration, will serve better than any argument of my own to show what science may thus accomplish.

EXAMPLES OF VARIABILITY, SELECTION, AND HEREDITY.

In the horse, conditions of life and climate produce the greatest variations. Mr. Charles Darwin, in his classical work on variation of domestic animals, gives some curious instances. Horses become "greatly reduced in size and altered in appearance by living on mountains and islands, and this is due apparently to want of nutritious or varied food." The horse can stand great cold. He is found wild in Siberia, as far north as fifty-six degrees; also, where it is very hot the horse flourishes, as in Arabia and Africa. A very moist climate seems to be more injurious to the horse than extreme heat or cold.

The English race-horse shows the effects of selection. These horses are descendants from the mingling of three races, called Arabs, Turks, and Barbs. Yet the improvement in these horses has been so marked that when descendants from the same stock of the first generation compete in the races, they are always allowed certain odds. As an example of heredity in racers may be mentioned "King Herod," who gained in prizes a million dollars, and was the father of four hundred and ninety-seven winners. "Eclipse," another great racer, was the father of three hundred and thirty-four winners. A German writer has asserted that there is not a successful racer on the continent of Europe which has not English blood in his veins.

With respect to sheep equally as valuable data have been collected. Quatrefages says: "Our [French] sheep on being transferred to America generally become acclimatized without undergoing great change. Their fleece, particularly, is retained. But on the plains of the Meta it is only retained on condition of the sheep being regularly shorn. If they are left to themselves the wool becomes of a felty nature, is detached in flakes, and is replaced by a short, stiff, and shining hair. Under the influence of this burning climate the same individual is in turn a woolly and a hairy animal." A cold climate even is capable of producing wool on animals which naturally do not have it. Some "pigs with fleece are found in the cold plateaus of the Cordilleras; sheep with hair in the warm valleys of the Madeleine, and hairless cattle on the burning plains of Maraquita." In the East there is a remarkable variation in sheep, by which a race has been formed by selections in which the tail is very long and deeply laid with fat, which is considered a great delicacy. "So highly prized is this character that the animals are furnished with trucks on which they drag their precious tails about from place to place." The differences in the texture of the wool, which make some races, like the pure Merinos, so valuable, have arisen by the combined influences of climate, heredity, and selection, and it is only by the most careful attention to selection that the fineness of the wool can be retained in other than the same climates in which it was at first produced. A remarkable instance of variation, which by heredity and selection was made to produce a new race, took place in our own country. "In 1791 a ram lamb was born in Massachusetts having short, crooked legs and a long back like a turnspit dog. From this one lamb the otter or Ancon semi-monstrous breed was raised. As these sheep could not leap over the fences, it was supposed they would be valuable." This breed, developed by selection, transmitted its character so perfectly that Colonel Humphreys, who made a special study of it, never heard of but "one questionable case." When the Ancons were placed in with other sheep they would keep together, gradually separating themselves from the rest of the flock.

Another instance, also cited by Darwin, relates to the formation of the Mauchamp breed. In the year 1828 a Merino ram lamb was born in France which was remarkable for its long, smooth, straight, and silky wool.

In 1833 M. Graux, the owner of the lamb, had raised enough to serve his whole flock, and in a few years more he was able to sell stock of his new breed. The wool is regarded so highly that it brings 25 per cent. more in the market than the best pure Merino.

Variation also frequently manifests itself by producing changes in the functions of the animal's body or some of its parts. These changes are mostly due to climate influences.

The Egyptian goose brought to France in 1841 by Geoffroy St. Hilaire, according to Quatrefages, is a striking example of this. "At first this bird laid its eggs in December, as in its native country. It raised its brood in the depth of winter, and, consequently, under very unfavorable circumstances. In 1844 the birds began to lay in February; in 1845 in March, and in 1846 in April, at the same time as the native goose." Sometimes instead of climate other forces are active in producing similar results. The same author states that "the wild sow litters but once a year and with only six or eight young, but when domesticated litters twice a year with from ten to fifteen pigs. The fecundity of the Indian pig is seven times as great under domestication as in a wild state."

On the other hand, there are some animals which appear to be less fruitful when tamed than when in the wild state.

I will not multiply these examples further. Those who feel like pursuing the subject will find abundance of material, collected from many classes of animals and different parts of the world, in Darwin's work, to which I have already referred.

These examples show what good results can be accomplished by paying strict attention to the laws which science has already discovered, and what progress we may expect from further investigations in the same line. There seems to be no more promising field for developing the relation of science to agriculture than in the one at which we have just taken a glance. A long series of carefully conducted scientific experiments will still be needed before we are able to determine what sheep will give the best wool in our climate, what cows the best milk, and what hogs the best pork.

In fact there is not a single domesticated animal which, by careful attention to variation and careful crossing and selection, may not have its nature better adapted to our climate, and thus become more profitable to the farmer. It is a good work and worthy of diligent prosecution.

BOTANY.

The science of botany is justly regarded as having a very intimate relation to agriculture. I have already indicated in a previous part of this paper how a botanist may be of great use in an experimental station in the examination of seeds. In the seeds of varieties, for example, nearly allied to each other, the seed may be so nearly alike that a skilled botanist will be required to detect the difference.

Taking advantage of this similarity, the unprincipled seller may mix the seed of a comparatively worthless variety with one which is highly esteemed and sell the mixture for the best seed. Just as often a dis-

"honest" grocer will mix coffee at thirty cents with coffee at forty cents, and sell the mixture for fifty cents a pound.

But the usefulness of botany to agriculture is not limited by the examination of seeds. It extends to a much wider field of activity.

All I have said of the variability, heredity, crossing, and selection in animals is equally true of plants. I will, therefore, not repeat here the course of reasoning used to show the usefulness of a scientific knowledge of these principles to the farmer. I will only say that as the farmer has to deal rather with plants than animals, the arguments have proportionately the greater weight here.

To variations and selections, crossing and heredity we are indebted for all the different varieties of the cereals and other plants which make them so well adapted to the different countries and climates in which they grow. As in the case of animals, I can best illustrate this by a few examples.

VARIATION, ETC., IN WHEAT.

Quatrefages relates that "the Abbé Tessier sowed autumn wheat in the spring. Of a hundred seeds which germinated only four ripened their seed. One hundred seeds of this crop (also sown in the spring) produced fifty fertile plants. In the third generation the whole hundred seeds ripened. An inverse experiment produced similar results."

The fact that good seed tends to produce good crops has been known from the earliest times. Darwin states that the careful selection of seed-corn was recommended in ancient times by Calumella and Celsus, and especially Virgil, who says in his Georgics:

I 've seen the largest seeds tho' viewed with care
Degenerate unless th' industrious hand
Did yearly cull the largest.

Wheat has been cultivated from the remotest antiquity, and without doubt the principles of selection have been practised from the first. It is thus probable that the limit of perfection, as far as selection is concerned, has long since been reached.

The chief value of selections, therefore, at the present time, is to preserve the high standard reached, while the botanist and experimenter must depend on crossing and accidental variations for the genesis of new varieties better suited to any given conditions of life. Nevertheless, existing varieties can be gradually acclimatized when taken to a strange country. In Sierra Leone when wheat was first sown it nearly all ran to leaf. The ears were few and poorly filled. When the seeds of this crop were sown many failed to germinate, but others grew and were much more fertile than the first crop. After a few years the wheat became as fertile as in its native country.

Another striking illustration of the effect of acclimatization in plants is afforded by the chrysanthemum. This plant, which is now so commonly seen, came originally from China. "Introduced into France in 1790, it flourished there and produced fruit which it was unable to ripen, so that commerce alone supplied gardeners with the necessary seed for more than sixty years. In 1852 a few plants were observed to flower and to fruit sooner than the others. The seed ripened, and France now produces all the seed which she requires."

Variation in the one species of cabbage has been most remarkable. By careful selection nearly fifty races have been produced and nearly one hundred and fifty varieties, extending all the way from the full-headed kind to the cauliflower.

In high northern regions the summers are short and the days long, and all kinds of crops grow there faster than in temperate climates, where the days are shorter and the summers longer.

In south Germany barley will grow and ripen in four and a half to five months; while in Lapland and Finland the same process is accomplished in two months.

Our common corn, as is well known, in Minnesota has six weeks less time to mature than in Southern Indiana and Kentucky, yet it soon adapts itself to the changed conditions. But if seed were taken from Kentucky and planted in Minnesota but few stalks would mature their seed the first year. Perhaps three or four years would be required for it to become perfectly acclimated. Thus, by easy inference, we see that where it is feared that frost will come too early in the fall it would be wise in the farmer to bring his seed each year from the North, and thus grow a crop which will ripen two or three weeks sooner than the acclimated plants.

By thoroughly trying experiments like these at our agricultural stations, botany may prove of immense advantage to the farmers of the country.

But I will not attempt here to show all the relations which botany holds to agriculture. There are a dozen directions in which its lines of useful force operate, and it would be wiser to leave a complete exposition of the subject to the professional botanist, who would bring to the task a richness of knowledge and facility of expression which would place the subject in a much stronger setting than I have been able to give it.

ENTOMOLOGY.

One of the numerous difficulties which adds to the burdens of the agriculturist is the fight which he is constantly carrying on against injurious insects. Almost every year he is compelled to engage in an unequal contest with the potato bug, the Hessian fly, the weevil, the caterpillar, and the borers of his fruit trees, while at intervals the locust, the army-worm, and the grasshopper pour over his fields with resistless power. It is the province of the entomologist to study the habits and methods of reproduction of these injurious insects, and to provide some way to arrest their almost marvelous fertility.

Much has already been accomplished in this direction, but much more remains to be done. It is evident that it is useless for a farmer to fight potato bugs in his field, while they are left to increase unmolested in the field of his neighbor. Action against insects must be concerted and intelligent to be effective. Bushwhacking and guerrilla warfare can never accomplish anything more than a local result. The campaign, to be effective, must be regular, with full equipments and a perfect knowledge of the ground to be fought over and the number and disposition of the forces of the enemy.

The farmer looks to the entomologist to direct him in the campaign and furnish him all needful information.

With such scientific aid he should not despair of eventually freeing his fields of these insignificant but destructive pests which now cause him so much loss and trouble.

These are only a few instances of the true relation science bears to one industry. The argument becomes cumulative as other industries are considered and other ties which connect them to science are discovered.

In these illustrations peculiar emphasis has been given to the real monetary value of science in the industry. And say what we will, this is the measure which is the final test of all value in every industry. What does not pay, at once or ultimately, will never find a lasting place. This does not arise from the fact that men are wholly mercenary, but happily from the fact that nature is so constituted that it is the best that always in the long run pays best.

TRUE PLEASURE ALWAYS MORAL.

Herbert Spencer has shown, in his admirable system of philosophy, that pleasure is the ultimate test of all virtue, morality and right living. What we call virtue, morality and right living, are really so because they confer finally on men the greatest happiness and afford them the greatest pleasure.

If a life of vice were at once and ultimately capable of producing greater pleasures, then vice would become virtue and virtue vice. And the same principle will be found underlying the industries and arts.

Those influences and conditions which at once or finally bring forth most from any given outlay of capital and labor, are the conditions and influences which are right and proper.

Science shows here its most intimate relations to every industry. It is its peculiar province to husband all natural resources, to make the most out of every exercise of energy, to direct in the right path every budding enterprise, and to open up new possibilities and secure new achievements in every form of organized labor.

DIFFUSION OF SCIENTIFIC TRUTH.

It would be, however, a great mistake to suppose that science has no other relation whatever to industries and arts aside from what is purely financial. There are indeed other true relations scarcely less important, which should be honored at least with some attention.

True science is eminently suited to diffuse general information among those actively engaged in the various industries. Anything which tends to impart useful information to those engaged in active labor, cannot fail of having an important effect on the industry itself.

To one pursuing any vocation of skill, there is danger of falling into grooves. It is sometimes hard to see beyond the confines of self-work and self-interest. That which concerns the laborer himself in the peculiar exercise of his trade, is apt to be the only thing which will excite his attention and hold his interest.

But a narrowness of view like this, is apt to beget prejudice, selfishness and bigotry. But prejudice, selfishness and bigotry react on the very force that begets them and tend to destroy both themselves and the industry they ostensibly protect.

One great function of science is to prevent such a condition. True science liberalizes and humanizes. I do not mean by science, mere dogma and pretense and hypothesis. Many condemn science without knowing what it really is. However plausible a theory may be, however strong the arguments which sustain an hypothesis, yet theory and hypothesis are not science.

I am far from denying the verisimilitude of many scientific theories and hypotheses. They may indeed prove, and often do prove, of great benefit; yet it is a great mistake to confound these with science itself — i.e., as already said, the "knowledge of matter and its laws."

Science, therefore, educates and liberalizes every trade and industry and art. Its cultivation will broaden the views of the people, dispel prejudice and superstition, remove feelings of narrow sectional pride, and make the whole world akin. When science is more broadly diffused, when it permeates more thoroughly the industries of the country, then there will be an end of humbugs and crazes, of isms and oddities, and the reign of common sense will supersede the reign of impulse and ignorance.

UNIVERSAL TRAINING NOT POSSIBLE.

I understand perfectly well, as already mentioned, that it is quite impossible that every artisan should receive a complete scientific schooling. However desirable such a thing may be, it is too Utopian to be considered here. Every farmer of the future will not be a graduate of an agricultural college, no matter if they may be made as numerous as high schools. But every farmer may feel the liberalizing power of scientific knowledge, and doubtless will feel it, although he may be unconscious of it. He cannot shut his eyes to the light which is abroad in the land. The lowliest slave will feel the warmth of the sun's rays, though he may not know that the sun's atmosphere contains sodium vapor. And thus it is with all kinds of scientific knowledge. Science will warm and vivify the whole world, though many may remain unconscious of the source of the new life which springs up within them.

No one can calculate the ponderous power for good which such influences will exert and do exert on the industries of the land, and that, too, aside from any idea of increased monetary value.

LOVE AND REVERENCE FOR THE TRUTH.

Science, while it reveals the constitution of matter and makes known the laws of its change, inculcates at the same time a love and reverence for the truth. No one can study carefully the inviolable verities of nature without realizing that truth is the only thing which can endure.

Science can neither be cajoled, threatened nor bribed. Science never lies and is never deceived by a lie. No boy can go through with the simplest exercise in chemical quantitative analysis, and not have his moral nature strengthened thereby. Reverence for the truth, hatred of error; these are two ideas which are always uppermost in the scientific mind. While, therefore, science spreads information, it also teaches morality. When every industry and art are fully imbued with these two ideas they will not only attain their maximum value as wealth-producers, but also become the most potent factors of happiness-making in the world. And every one wishes to see this. Honest industries, skilled arts, honest laborers, skilled artisans; these are the pride and the salvation of the country.

I have not time to discuss this subject further. At the very beginning I was oppressed with the thought that in one short essay I could not more than make a fair introduction of the subject. I repeat the thought in closing with which I began: Science is the mother of industries and arts. She is the mother who brings them forth, and it is always parthenogenesis. She is the mother who protects them in the years of their helpless infancy. She is the mother who instructs them in knowledge and morality, and finally she is the mother who looks upon their successes with loving pride.

With such influences working on our industries and arts, the future seems bright with near possibilities. We see our industries vivified with new life and new usefulness. We see them liberalized and educated. We see them permeated with love of truth and morality. We see them feeding hundreds of millions of people at home, and covering the seas with their products. We see homes made happier and life made easier to the millions of toilers. Labor is no longer a mere drudgery, but a constant pleasure. Knowledge and industry will march hand in hand to higher usefulness and higher attainment, and in these happy results we will see realized in all the intimacy of their kinship, the "true relation of science to the industries and arts."

XXVIII

UNCLE SAM'S BIG COLLEGE

THE constitution of the State of Michigan which was adopted in 1850 made provision for an agricultural school. This school was opened in 1857, and is now in a high state of efficiency and prosperity. The Pennsylvania State College, which is essentially a school of agriculture, grew out of The Farmers' High School, which was incorporated in 1854 and opened for students in 1859. In 1856 the legislature of Maryland incorporated the Maryland Agricultural College, located almost on the edge of the District of Columbia, and in the same year the legislature of Massachusetts issued a charter to the trustees of the Massachusetts School of Agriculture. The above is a résumé of the earliest efforts of the States to promote agriculture as a distinct science.

VETOED BY PRESIDENT BUCHANAN.

Justin S. Morrill, of Vermont, introduced in the House of Representatives, of which he was a member, in 1858, a bill to promote education in agriculture and the mechanic arts. On the 22d of April, 1858, Mr. Morrill's bill was adopted by the House of Representatives by the close vote of 105 to 100. On February 7, 1859, the Morrill bill passed the Senate of the United States by another close vote, namely, 25 to 22. Soon after this the House and Senate agreed on the amendments to the bill, but on February 24th James Buchanan, President of the United States, vetoed the measure on the ground that he did not think the time was opportune and that the possible effect which it could have upon the relations existing between the federal and state governments was of doubtful value, and for the further reason that he doubted the power of Congress to appropriate money for education in the States, and therefore in his opinion the aid of such education by means of a land grant was of doubtful constitutionality.

Mr. Morrill, however, was not discouraged by this adverse opinion of President Buchanan. In view of the strained relations of affairs at that time, due to the agitation of the slavery question, and the uncertainty in Mr. Buchanan's own mind about what should be done and what should not be done, it was not strange that he refrained from approving any measure which would, even by implication, invalidate the doctrine of States' rights. While the theory of States' rights is still held, there is no longer any disinclination on the part of any of the States to receive the benefits of a federal grant of money for any purpose whatever. It is the old question of "What is the constitution among friends," when an appropriation is at stake.

APPROVED BY PRESIDENT LINCOLN.

In 1861 Mr. Morrill introduced into the House of Representatives practically the same bill which had passed before, granting 30,000 acres of land for each member of Congress for the establishment of colleges in each of the States, and on the 2d of May, 1862, Senator Wade, of Ohio, introduced a similar bill in the Senate. Mr. Morrill's bill was reported adversely

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First Secretary of Agriculture

by the Committee on Public Lands, but it was passed by the Senate on June 10th, and nine days later by the House of Representatives. President Lincoln made the bill a law by affixing his signature July 2, 1862. Thus the name of Senator Morrill has become indissolubly connected with federal aid to agricultural, mechanical and military education.

Twenty-eight years after this grant of Government lands to the States for educational purposes, the principle of appropriating money directly from the Treasury for the same purpose was enacted into law. This was also accomplished largely by the aid of Mr. Morrill, who had then become a Senator. A bill appropriating money for such service was approved by President Harrison on August 30, 1890. Under this act the sum of $15,000 a year, beginning with 1890, and an increase of the amount of such appropriation for ten years thereafter by an additional sum of $1,000, until at the end of ten years the total appropriation should become $25,000 annually, was appropriated to each State.

Meanwhile efforts were made, also, to support from the federal treasury the experimental work of agriculture in the various States. The establishment of the colleges of agriculture and mechanic arts, including instructions in military science, was a powerful stimulus looking to the establishment of stations for conducting agricultural experimental work. About 1883 a bill granting funds from the federal treasury for this purpose was introduced by Representative Carpenter, of Iowa, but failed of passage. The measure, however, was supported by the agricultural colleges of the country, and subsequently became a law. Under the lead of Mr. Hatch, of Missouri, a bill bearing his name appropriated $15,000 to each State and territory out of funds proceeding from the sale of public lands for the establishment and maintenance of an agricultural experiment station, as a department of the land-grant colleges established under the act of 1862. This act passed the House of Representatives and the Senate, and was approved by President Cleveland on the 2d of March, 1887.

BENEFITS TO THE STATES.

The benefits arising from the establishment of agricultural experiment stations in the various States were of such a patent character that it was not long before increased facilities for such experimentation were provided for by the appropriation of federal funds. Under the lead of Representative Adams, of Wisconsin, an act was finally passed providing for an increased appropriation over that established by the Hatch Act, namely, $15,000 a year. The Adams Act provided for an increase of $5,000 for the fiscal year of 1906, increasing this amount by $2,000 annually until the total amount reached $15,000, the same as provided for in the Hatch Act. Thus the total amount provided for each State for experimental work in agriculture from the federal treasury is now $30,000 per year. The act providing for this increase was passed on the 16th of March, 1906.

PROMOTING AGRICULTURAL EDUCATION.

Subsequently a successful attempt was made to increase the funds available for agricultural education under the lead of Senator Nelson, who succeeded in introducing an amendment to the agricultural appropriation bill which provided that for the fiscal year 1908 an additional $5,000 be appropriated, and this amount be increased by \$5,000 each year for four years, thus securing for each State a sum of \$25,000 in addition to that carried by the Second Morrill Act. This amendment also contained the provision "that said colleges may use a portion of this money for providing courses for the special preparation of instructors for teaching the elements of agriculture and the mechanic arts."

The total amount of appropriations of the federal government for the colleges of agriculture and mechanic arts for the years from 1890 to 1914, are as follows:

1890	\$ 660,000
1891	704,000
1892	782,000
1893	864,000
1894	912,000
1895	960,000
1896	1,008,000
1897	1,056,000
1898	1,104,000
1899	1,152,000
1900	1,200,000
1901	1,200,000
1902	1,200,000
1903	1,200,000
1904	1,200,000
1905	1,200,000
1906	1,200,000
1907	1,200,000
1908	1,500,000
1909	1,750,000
1910	2,000,000
1911	2,250,000
1912	2,500,000
1913	2,500,000
1914	2,500,000
Total	\$33,802,000

The last contribution of the national government to agricultural education has been made under an Act of Congress approved May 8, 1914, granting ten thousand dollars a year to each State to promote agricultural extension work. According to Section 2 of this act the character of the work to be done is defined as follows:

> That coöperative agricultural extension work shall consist of the giving of instruction and practical demonstration in agriculture and home economics to persons not attending or resident in said colleges in the several communities, and imparting to such persons information on said subjects through field demonstrations, publications, and otherwise; and this work shall be carried on in such manner as may be mutually agreed upon by the Secretary of Agriculture and the State Agricultural College or colleges receiving the benefits of this Act.

The appropriation of $480,000 is made to carry the provisions of this Act into execution. This sum is to be increased, year by year, according to the following provisions: $600,000 for the second year, and for each following year a sum exceeding by $500,000 the sum appropriated for each preceding year, and for each year thereafter there is permanently appropriated for each year the sum of $4,100,000 in addition to the sum of $480,000 hereinbefore provided. This makes the enormous sum of $4,580,000 which will be appropriated permanently from the Treasury of the United States for the promotion of practical demonstrations of agricultural processes. To this must be added the $4,100,000 which States must contribute, making the total sum annually available $8,600,000!

DANGER OF OVER ENDOWMENT.

I am of the opinion that agriculture is being too generously endowed in this country. Overfeeding is one of the gravest dangers of the growing organism. Agriculture is a growing organism. It is likely to be overfed until it becomes over-fat, in which condition it will naturally lapse into a condition of lethargy, inactivity and decay. Just as our colleges and universities and foundations of different kinds are becoming over-endowed, just so agriculture is in danger of pampering and coddling. We may well pause on the threshold before entering upon an era of agricultural myxedema.

I would be the last one to oppose any necessary agricultural endowment. I have seen, however, during my career in the public service, such a wanton waste of money, due to huge gifts for this and that purpose, as to make me skeptical of the wisdom of such enormous grants. Already the Department of Agriculture is expending twenty million dollars a year, which is more than ten times as much as it was spending when I first became attached to it in 1883. Within a year or two, at the present rate, the expenditures will amount to twenty-five millions of dollars, and unless some check is placed upon these extravagant appropriations another twenty years will see forty millions of dollars appropriated to the federal Department of Agriculture.

The growth of the Department has been truly phenomenal, especially from the time of Hon. Norman J. Coleman the first Secretary of Agriculture and during the incumbency of the Hon. James Wilson, who was Secretary for sixteen years.

Healthy growth can come only from strenuous effort, and the man who sits at a table bountifully spread, who goes thence to digestion in a Morris chair, and then retires in the soft draperies of a luxurious couch, is not likely to make any mark in the world except that of his grave. All his virility, his initiative and originality will be appropriated by Congress and will ooze out of the Department of Agriculture. The great success of agricultural work in this country will not be through the hot-house plant. The simple, direct experiments which do not cost much money, and the results of which are couched in plain and simple language for the benefit of the practical farmer, will do more than all the "show me" business that you can possibly imagine. Most interesting has been the debate in the Senate on the present appropriation bill of 1914. The Senators themselves called attention to some of the crudities and dangers of this unbridled use of money.

The following table shows the schedule of appropriations under the last educational Act:

Fiscal year	Basic fund $10,000 to each State	Additional Federal appropriation to be distributed in proportion to rural population	Total Federal appropriation
1914–15	$480,000	....	....
1915–16	480,000	$ 600,000	$1,080,000
1916–17	480,000	1,100,000	1,580,000
1917–18	480,000	1,600,000	2,080,000
1918–19	480,000	2,100,000	2,580,000
1919–20	480,000	2,600,000	3,080,000
1920–21	480,000	3,100,000	3,580,000
1921–22	480,000	3,600,000	4,080,000
1922–23	480,000	4,100,000	4,580,000
1923 and thereafter	480,000	4,100,000	4,580,000

STATE MUST HELP.

One of the important conditions of the Act is that each State must duplicate the money above $10,000 a year appropriated to it by the federal government. The money raised by the State may come from the State, county, college, local authority, or individual contributions from within the State, for the maintenance of coöperative agricultural extension work. The governor of each State, in the interval until the legislature meets, is called upon to designate the agricultural college or colleges to which the federal funds are to be paid.

A limitation is placed upon the use to which the funds appropriated by the United States are to be put. No money appropriated by the United States shall be applied, directly or indirectly, to the purchase, erection, preservation, or repair of any building or buildings, or the purchase or rental of land, or in college-course teaching, lectures in colleges, promoting agricultural trains, or any other purpose not specified in the Act.

Not more than 5 per cent. of each annual appropriation may be applied to the printing and distribution of publications, and this means that 95 per cent. of the appropriation must be devoted to the giving of instruction and practical demonstrations to persons not attending the colleges.

If any grant of the federal government be lost, mismanaged, or misapplied in any way, the State responsible must make good the sum before receiving any further federal appropriations.

There is no other country in which agricultural education and experimentation are so munificently endowed. I fear at times that too much money is available. The funds have come more rapidly than experience to handle them. There is no blight so deadly as that of luxury. I know of no Bordeaux mixture to limit its ravages.

TEACHING AGRICULTURE IN THE PUBLIC SCHOOLS.

Nineteen States now require that an examination in agriculture be passed before a teacher may obtain a certificate. This is an indication that training in the elements of agriculture is soon to be an important part of the public school system. During the two years ending March, 1912, the number of institutions giving courses in agriculture increased at the rate of more than 75 a month, going from 1,863 to 2,575. Many normal schools are also introducing courses of agriculture, in order that teachers may have an opportunity to prepare themselves for these required examinations. Summer schools are also largely adopting courses of study in agricultural work, because teachers may readily attend these summer schools without interfering with their regular work in the classroom.

The agricultural and mechanical colleges of the country are also beginning to hold special courses for the use of teachers. This is done by the North Carolina College, as well as by some others. Afternoon, evening and Saturday classes in agriculture are also offered at Columbia University, in the city of New York. Reading courses have been organized in agriculture by the University of Arizona, the Michigan Agricultural College, New Hampshire College, Cornell University and the State University of Columbus, Ohio.

The Department of Agriculture has organized a free reading course for the benefit of those who are unable to attend regular college work. A list of Bulletins and other publications which are to be read by correspondents has been prepared, and may be had free by applying to the Superintendent of Documents, at Washington, D. C.

There are eight courses offered, which cover thoroughly the subjects treated. They are as follows:

1. Agronomy;
2. Animal Husbandry;
3. Horticulture;
4. Forestry;
5. Agricultural Engineering;
6. Agricultural Technology;
7. Agricultural Economics;
8. Agricultural Education.

As a sample of what these courses contain, the list of the bulletins given under the heading "Animal Husbandry" is given on the next page.

Besides outlining these courses, the bulletin contains lists of institutions maintaining courses in agriculture in summer sessions, extension courses, and correspondence courses. Similar courses are offered in other branches of farming.

The latest available data of the activities of the land-grant colleges are contained in the publication of the Department of Agriculture entitled "Statistics of Land-grant Colleges and Agricultural Experiment Stations, 1912," [2] issued by the Department of Agriculture as a part of the Annual Report of the Office of Experiment Stations for the year ended June 30, 1912. At that time the total number of land-grant colleges was 67, and at least one was found in all the States and territories except Alaska.

TOTAL VALUE OF LAND GRANT ENDOWMENT.

The aggregate value of the land-grant fund as a permanent endowment under the Act of 1862 is

[2] Summary of the Condition of the Agricultural and Land Grant Colleges at the End of the Fiscal Year Ending June 30, 1912.

ANIMAL HUSBANDRY

Topic	Title	Department's Farmers' Bulletin Number or Year Book
Bees	Bees	447
Birds	Some Common Birds	54
	Some Common Game, Aquatic, and Rapacious Birds in Their Relation to Man	497
	Fifty Common Birds of Farm and Orchard	513
	Does It Pay the Farmer to Protect Birds?	Year Book Sep. 443
Cattle	The Dairy Herd	55
	Breeds of Dairy Cattle	106
	Tuberculosis	473
Hogs	Pig Management	205
	Hog Cholera	379
Sheep	Raising Sheep for Mutton	96
Poultry	Standard Varieties of Chickens.	51
	Ducks and Geese	64
	Turkeys	200
	The Guinea Fowl	234
	Poultry Management	287
Feeds and feeding ...	The Feeding of Farm Animals.	22
	Sheep Feeding	79
	Principles of Horse Feeding...	170

$13,533,868.64; other land-grants under other acts, $3,390,215,83; other endowments, $20,129,479.44. A part of the land-grant of 1862 is still unsold, the value of which is estimated about $5,165,209.81. The value of the farms and grounds owned by the agricultural colleges is $22,023,266.60; the value of buildings used for college purposes is $44,459,391.12; the total value of scientific apparatus, machinery and furniture is

$12,594,728.25; the value of the libraries connected with the institutions is $5,636,297.92; the value of the live stock on the farms is $796,959.66; making the total value of all kinds in the agricultural colleges $127,729,315.17. Exclusive of the income derived from the United States for the agricultural experiment stations, these institutions receive from the States for current expenses $6,937,410.97; for increase of buildings and plant, $4,647,746.97; they also have received as an endowment from other than federal or state grants $660,779; as tuition and incidental fees $3,654,050.11; from private gifts $2,384,947.71; and from miscellaneous sources $2,296,065.41. Including the appropriations from the United States the total amount of money available for the annual expenses of these institutions is $25,967,130.45. During the year 1912 it is estimated that the increased funds at the disposal of these institutions were as follows: Permanent endowment, $1,809,100.40; buildings, $4,721,467.79; libraries, $283,725.62; scientific apparatus, $573,186.90; machinery, $270,547.61; live stock, $141,412.15; miscellaneous, $438,721.40; making a total increment of wealth for the land-grant colleges for one year of $8,238,161.87. The total value of properties owned by the institutions, as already stated, is, in round numbers, $128,000,000. Allowing for an increase of $10,000,000 for 1913-1914, the total value of the equipment owned by the land-grant colleges at the present time is almost $150,000,000!

NUMBER OF PERSONS IN THE TEACHING FORCE AND STUDENTS.

In the schools of agriculture and the mechanic arts devoted to white students, were found the following number of teachers and professors at the end of the fiscal year June 30, 1912: Teachers in the preparatory classes, including the secondary schools of agriculture, 626; professors in the collegiate classes of agriculture and the mechanic arts, and in all other forms of instruction in these colleges, 3,569; making a total number of teachers of 3,835. In addition to these there were 161 instructors giving full time and 525 giving part time to agricultural-extension work; 1,583 officers of experiment stations; and 2,705 persons in the faculties of other colleges or departments not devoted to agriculture; making a total of 7,192 teachers and instructors in the land-grant institutions.

In like manner for the colored institutions there was a grand total of 474 persons in the teaching corps.

The number of students in the colleges for white persons in actual attendance at the institutions was 53,764. There were also enrolled in correspondence courses 33,149; in extension courses, not including farmers' institutes, 106,516; and in all other departments of the institutions, 32,685. Thus the total number of white students receiving instruction from these institutions during the year ended June 30, 1912, was 242,954.

The total number enrolled in schools for colored persons was 8,495.

The number of graduates from the land-grant institutions for white students during the year ended June 30, 1912, was 8,370, distributed as follows: Agriculture, 1,200; mechanic arts, 2,260; home economics, 427; all other courses, 4,494. The total number of graduates since the institutions were founded amounts to 103,736.

In the schools for colored persons the total number of graduates for the year ended June 30, 1912, was

131, and the total number since the organization of these institutions, 7,458.

The total number of acres of land granted to the States under the act of 1862 was 10,570,842, of which 652,617 acres are still unsold.

MUNIFICENT HELP TO AGRICULTURAL EXPERIMENT STATIONS.

Important also are the figures showing the expenditures for the work of the agricultural experiment stations. The total income of the stations maintained under the acts of 1887 (Hatch fund) and 1906 (Adams fund) was $4,068,240.09, of which $720,000 came from the Hatch fund and $720,000 from the Adams fund. The remaining portion of the income, namely, $2,628,240.09, came from the following sources: State governments, $1,492,798.12; individuals and communities, $54,878.51; fees for analyses of fertilizers, $129,884.61; sales of farm products, $230,271.81; miscellaneous, including all unexpended balances, $720,407.04. In addition to this sum, the Office of Experiment Stations at Washington had an appropriation for the fiscal year of 1912 of $424,000, which includes $30,000 each for the Alaska, Hawaii and Porto Rico Experiment Stations, $15,000 for the Guam Experiment Station, $15,000 for nutrition investigations, $100,000 for irrigation investigations, $100,000 for drainage investigations, and $10,000 for farmers' institutes and agricultural schools.

PROFESSORS, DIRECTORS, AND EMPLOYEES.

The agricultural stations employ altogether 1,583 persons in the work of administration and research, classified as follows: Directors, 57; assistant directors, 25; chemists, 250; agriculturists, 32; agronomists, 91; animal husbandmen, 120; dairymen, 90; veterinarians, 60; entomologists, 101; botanists, 61; horticulturists, 121; poultrymen, 40; plant pathologists, 61; zoölogists, 3; meteorologists, 9; pomologists, 16; foresters, 21; mycologists, 21; biologists, 7; geologists, 2; plant breeders, 16; bacteriologists, 40; animal pathologists, 8; viticulturists, 5; soil specialists, 50; irrigation and drainage engineers, 26; agricultural engineers and farm mechanics, 15; extension work and farmers' institute directors, 19; farm management, 6; animal nutrition, 11; fertilizer and feed inspectors, 16; agricultural education, 5; in charge of substations, 55; farm and garden foremen, 43; secretaries and treasurers, 22; and librarians, 22.

From the above summary it is possible to estimate the gigantic work, in so far as material means are concerned, which is undertaken by the federal and State governments for the teaching of agriculture and the promotion of agricultural research. This army of graduates and students is distributed all over the country and through our territorial possessions. They carry with them the principles of scientific agriculture, and by precept and example are able to teach these principles to the farmers at large. It is somewhat remarkable, in view of these tremendous expenditures of energy directed towards the improvement of agricultural conditions, that the average yield of the fields has been increased, if at all, by only small quantities. The ravages of disease and the scourges that infect, annoy and destroy crops and farm animals, are yet apparently unchecked. These negative results, in so far as practical advantages are concerned, are, however, not to be too seriously considered. A third of a century ago all American agriculture was on the downward path, racing as rapidly as possible to reach the minimum of production. It had gathered momentum in its downward course and it has required all these years to check its progress. The sudden growth of agricultural education and experimentation produced a paucity of properly qualified employees. It would be interesting, if it could be ascertained, to know what percentage of the vast sum expended in these activities during the past third of a century has been absorbed by training directors and experimenters and how much has been wasted on incompetents and agricultural vagaries! This, if known, must explain the absence of material crop increase.

Now we may hope that this downward course has been stopped. There are even signs of a movement in the opposite direction. There is every reason to believe that this movement will become accelerated and that there will be a gradual, and for some time hastened, progress towards a maximum of production. It is not difficult to conceive of the soils of this country, under such scientific direction, producing three times as much human food and clothing as they do to-day, without any appreciable expansion of acreage. When that result shall have been obtained, the full fruition of this great work in agricultural education will have been realized, and Uncle Sam's big college be fully appreciated. In this connection we should not forget the credit due to Hon. Jeremiah Rusk, the second Secretary of Agriculture, 1889-1893, who was an enthusiastic promoter of agricultural education.

XXIX

UNCLE SAM'S BIG FARM

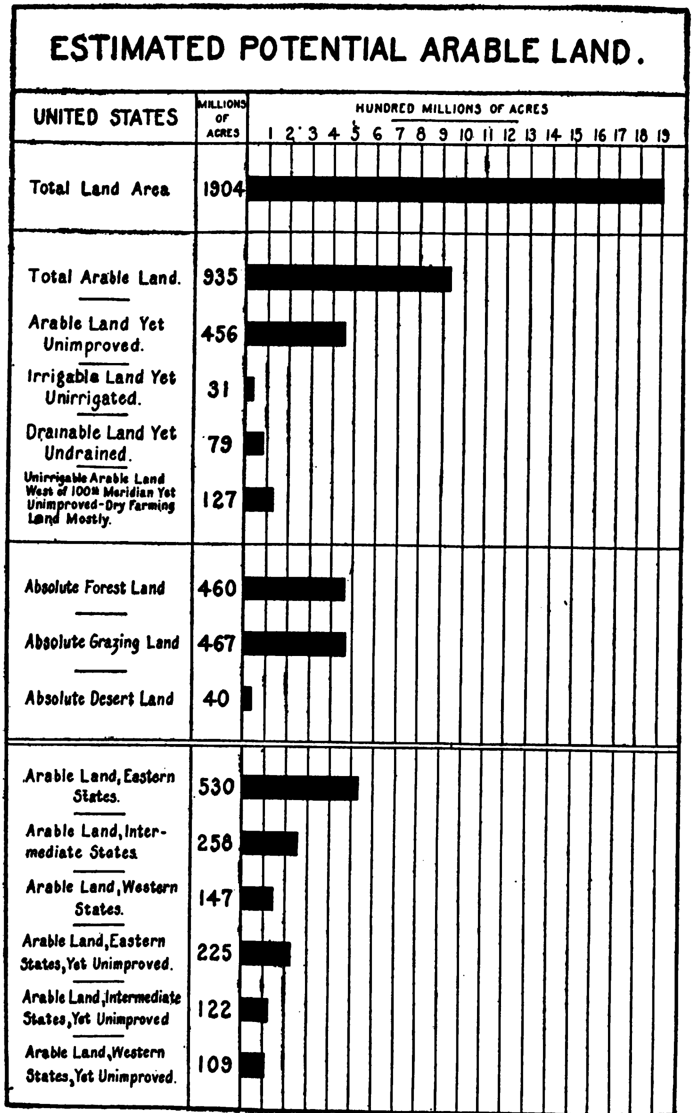
MANY of the citizens of the United States who are patriotic and proud of their country have nevertheless vague ideas concerning the extent of Uncle Sam's Big Farm. I have applied for information on this point to the Department of Agriculture, and have been courteously furnished with the following data:

First of all I call attention to the chart, which shows in a graphic manner the extent of the land area of the United States and of the different kinds of land therein, namely, arable, irrigable, drainable, forest, grazing and desert. This chart gives at a glance and in a comparative way most valuable information. In submitting these data I call particular attention to the caution given by the Department of Agriculture in transmitting the estimates, by reason of the very difficult task of securing absolutely reliable data on all these points. The officials of the Department emphasize the fact that the data rest upon many variable factors that vitiate more or less such estimates as these; nevertheless they are undoubtedly the most accurate which have been made, and while further investigations may change them slightly they may be accepted as approximately correct.

Especially is it difficult to give accurate forecasts of the areas which may be brought under cultivation in the future by reason of reclaiming swamps and deserts. In the opinion of the Department utilization of land

JAMES WILSON

"The growth of the Department has been truly phenomenal especially during the incumbency of Hon. James Wilson, who for sixteen years was secretary of agriculture"


ESTIMATED POTENTIAL ARABLE LAND.
UNITED STATES
MILLIONS OF ACRES
HUNDRED MILLIONS OF ACRES
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19
Total Land Area 1904
Total Arable Land. 935
Arable Land Yet Unimproved. 456
Irrigable Land Yet Unirrigated. 31
Drainable Land Yet Undrained. 79
Unirrigable Arable Land West of 100th Meridian Yet Unimproved-Dry Farming Land Mostly. 127
Absolute Forest Land 460
Absolute Grazing Land 467
Absolute Desert Land 40
Arable Land, Eastern States. 530
Arable Land, Intermediate States 258
Arable Land, Western States. 147
Arable Land, Eastern States, Yet Unimproved. 225
Arable Land, Intermediate States, Yet Unimproved 122
Arable Land, Western States, Yet Unimproved. 109

for crops will probably never reach the total estimated area of potential arable land. On the contrary, with increasing population and improved methods of marketing, the trend will probably be towards the more intensive cultivation of the more fertile or favorably situated land, and the more extensive cultivation of the less valuable land, as is illustrated in China. This trend is particularly evident in California, where the wheat acreage declined between 1899 and 1909 from 2,683,405 acres to 478,217 acres, while the area planted to alfalfa, vegetables and fruit, increased during the same time 340,000 acres. During this time, also, 569,000 acres reverted to unimproved land, and approximately 900,000 acres were transformed into improved pasture.

It appears from the investigations that have been made that the acreage of arable land in the Eastern part of the country will not increase very greatly unless lower prices of labor render the use of machinery less profitable, and permit a return to the cultivation of the hillside by hand. On the contrary, in the Western part of the country, with rising prices of beef cattle, the tendency is likely to be towards an increase rather than a diminution of the land devoted to pasture.

The points in the graphic chart which are particularly interesting are: First, the total land area of the United States, and this of course does not include any of its territorial possessions, is, in round numbers, 1,904,000,000 acres. The total land suitable for culture, that is, arable land, is 935,000,000 acres, a little less than half of the total area. The land suitable to cultivation which has not yet been brought under the plow is 456,000,000 acres, and the possible irrigable land still un-irrigated 31,000,000 acres, and the possible drainable land yet undrained 79,000,000 acres. The arid area not possible of irrigation by reason of the lack of water, but some of which may be devoted to dry-farming, is 127,000,000 acres; forest lands totally unsuitable for agriculture, 460,000,000 acres; forest lands suitable for grazing, 467,000,000 acres; and desert land of which there is no hope for any purpose, 40,000,000 acres. These subdivisions of the different kinds of land are summarized in following tables:

From the estimate of 935,000,000 acres of arable land there should probably be deducted:

Land in roads, 12 acres for every section (640 acres) of arable land, or about	17,700,000	acres.
Land in farmsteads, possibly 2 acres for each of the 6,361,000 farms, or about	12,700,000	"
	30,400,000	"

The loss of arable land because of fences would probably equal the loss from roads,
Leaving a total arable area of 900,000,000 acres, or less.

		Acres.
1.	Area of irrigated land in United States, 1910 (census)	13,738,485
2.	Approximate area irrigated at present	15,500,000
3.	Estimated area of irrigated land when all available water is used and transported by present methods, less necessary deduction for drainage, proportionate acreage of different crops remaining as at present	50,000,000
4.	Estimated area of irrigated land when all available water is transported with minimum waste without regard to cost of construction of conduits, less necessary deduction for drainage, proportionate acreage of different crops remaining as at present	65,000,000
5.	Estimated area of irrigated land with most perfect known transmission of water and opti-	

TABLE I.—ARABLE LAND

	Eastern States (Humid.)	Intermediate States, (Tex., Okla., Kans., Neb., S. D., and N. D.)	Western States (Largely arid.)	United States
Total land area	741,904,000	407,964,800	753,420,800	1,903,289,600
Estimated arable land	530,000,000	258,000,000	147,000,000	935,000,000
Per cent. of land area arable	71.4%	63.3%	19.5%	49.2%
Classification of Arable Land:				
A. Improved land in farms	305,017,793	135,480,947	37,953,010	478,451,750
B. Irrigable land yet unirrigated	....	3,460,000	27,850,000	31,310,000
C. Drainable land yet undrained	71,351,000	3,955,000	3,694,000	79,000,000
D. Unirrigable arable, west of 100th meridian, yet unimproved. (Dry farming mostly.)	....	50,000,000	77,000,000	127,000,000
E. Other unimproved farm land, probably arable	70,000,000	47,000,000	Included in B, C, and D	117,000,000
F. Other land not in farms, probably arable	84,000,000	18,000,000	Included in B, C, and D	102,000,000
Total arable	530,000,000	258,000,000	147,000,000	935,000,000

E. Unimproved farm land, 1910	185,178,541	142,263,835	72,909,199	400,346,575
(1) Absolute farm wood-lots (based on estimates of Mr. Zon)	75,000,000	15,000,000	10,000,000	100,000,000
(2) Absolute swamp land in farms (based on estimates of Mr. McCrory)	Practically none	0	0	0
(3) Absolute grazing land in farms (rough estimate based on Census Stat.)	....	40,000,000?	27,000,000?	67,000,000?
Unimproved farm less (1), (2), and (3) and a portion of B, C, and D	70,000,000 (plus 40,000,000? drainable)	47,000,000? (plus portions of B, C, and D)	....	....
F. Land not in farms	251,712,666	130,220,018	642,558,591	1,024,401,275
(1) Absolute forest land (based on estimates of Mr. Hall and Mr. Zon)	135,000,000	15,000,000	210,000,000	360,000,000
(2) Absolute swamp land not in farms (based on estimates of Mr. McCrory)	1,500,000	(Practically none)	(Practically none)	1,500,000
(3) Absolute grazing land not in farms (based on estimates of Forest Service, Land Office, and Census Statistics)	....	80,000,000?	320,000,000?	400,000,000?
(4) Absolute desert land	....	....	40,000,000	40,000,000?
Land not in farms less (1), (2), (3), and (4) and a portion of B. C, and D	84,000,000? (plus 31,000,000? drainable)	18,000,000? (plus portions of B, C, and D)	....	....

	mum utilization upon the fields, less necessary deduction for drainage, proportionate acreage of different crops remaining as at present ..	90,000,000
6.	Probable area which could be profitably irrigated at present prices of farm products, labor, land, and capital	45,000,000

MAGNITUDE OF THE AREA OF SOME OF THE LEADING CROPS.

INDIAN CORN.

The area planted to Indian corn in the United States is slightly above 100,000,000 acres. In 1913 the area was 105,000,820 acres.

Inasmuch as Indian corn covers the largest area devoted to any one cultivated crop in the United States, the comparative areas cultivated in other countries to this crop will be of interest. The total area in Indian corn for 1913 was:

	Acres
In Canada	16,278,000
In Argentina	9,464,000
In Austria	705,000
In Hungary	6,422,000
In Italy	3,888,000
In Roumania	5,305,000
In Russia	4,233,000
In Spain	1,105,000
In the Philippine Islands	988,000
In Algeria	24,000
In Australia	320,000

It is thus seen that the area planted to Indian corn in the United States is considerably larger than that of all the other nations of the world. The largest yield of Indian corn in the United States was harvested in 1912, totaling 3,124,746,000 bushels. The total production of the world for the same year was 4,362,-288,000 bushels. Thus it appears that the production of Indian corn in the United States is almost three times as great as that of all other countries.

OTHER CEREALS.

The area planted to wheat in 1914 in the United States is estimated at 35,387,000 acres of winter wheat and 17,990,000 acres of spring wheat, a total acreage of 63,377,000. The yield for 1914, estimated on reliable data, is considerably in excess of 900,000,000 bushels. The area planted to oats in the United States in 1914 is estimated at 38,383,000 acres. The area planted to barley in 1914 is estimated at 7,528,000 acres. In 1913 the yield of oats was 1,121,768,000 bushels. Compared with other countries for 1913, the following data are given:

Total yield of oats:

	Bushels
In Canada	404,669,000
In South America	121,879,000
In Europe	2,960,929,000
In Asia	500,000
In Africa	31,768,000
In Australia	16,625,000
In New Zealand	14,013,000
For the whole world	4,672,168,000

The comparative yields of rye in 1913 are shown by the following data:

	Bushels
United States	41,381,000
Canada	2,300,000
Mexico	70,000
Europe	1,840,695,000
Asia	32,953,000
Australia	110,000

	Bushels
New Zealand	90,000
Total for all the world	1,884,646,000

POTATOES.

The area planted in potatoes in the United States for 1912 was 3,711,000 acres, and the yield 420,647,000 bushels. As compared with other countries the yields are as follows:

	Bushels
In Canada	84,885,000
In Mexico	924,000
In Newfoundland	1,524,000
In South America	59,656,000
In Europe	5,237,364,000
In Asia	118,774,000
In Africa	3,800,000
In Australia	11,256,000
In New Zealand	5,410,000
Total for the world	5,945,846,000

The areas of other crops in the United States are as follows: Flax, 1914, 1,927,000 acres; sugar beets, 580,006 acres; yielding 5,659,462 tons of beets, with an average production of sugar of 259 pounds per ton. The total production of cane sugar in the United States for 1913 was 299,698 tons, and the total domestic production of sugar, exclusive of Hawaii, Porto Rico and the Philippines, was 1,033,099 tons. During the same period there were produced in Hawaii 546,524 tons of cane sugar from 53,600 acres of cane. The total area planted to cotton in the United States in 1913 is estimated at 37,458,000 acres, yielding an average of 182 pounds of cotton per acre in spite of the boll weevil. Of the remaining areas not accounted for in the above data, that are suitable for agricultural purposes, the greater part is in meadow 48,400,000 acres and pasture.

FOREST PRODUCTS.

Uncle Sam's big forest extends over many millions of acres, but few of us know anything definite regarding the magnitude of business connected with forest activities. A careful estimate made by the Bureau of Forestry shows that about 45,000,000,000 feet of lumber of all kinds are produced annually in the United States. Of this quantity about 25,000,000,000 feet, board measure, are subjected to further manufacture, and the rest of it is used for rough construction lumber and general purposes. The above estimate does not include any material which reaches its final use in the form of fuel, railroad ties, posts, poles, pulpwood, cooperage, wood distillates, and the barks and extracts consumed in the tanning industry.

About one hundred different kinds of wood are used in this country for different purposes. The softwoods and the needle-leaf, or coniferous trees, are most important. There is, however, a large number of species and varieties among the hardwoods, or broadleaf trees. Yellow pine leads the list of different kinds of trees in furnishing more than eight billion feet of lumber, followed by white pine with three billion feet, and Douglas fir with a little more than two billion feet. The term "yellow pine" includes several species, the three most important of which are longleaf, shortleaf and loblolly. All the different kinds of oak furnish about two billion feet, and oak is the most important of the hardwoods, maple coming next in order.

A tree which is little known, as a rule, for lumber purposes, namely, dogwood, furnishes more than seven million board feet.

There are not less than fifty-five manufacturing industries which use wood as a raw material. More than one-half of the total lumber that is manufactured consists in planing mill products, the largest items of which are flooring, siding, ceiling, and finishing. The next most important industry in which wood is used is in the manufacture of boxes and crates. It is estimated that nearly four times as much is demanded in the manufacture of boxes and crates as is used by the builders of steam and electric cars, and five times as much as that which is used for furniture. Vehicles demand large supplies of wood, and this must be of a high class in order to meet the requirements for frames, gears and bodies.

Chairs, listed separately from furniture, come after novelties and supplies for dairymen, poultry keepers, and apiarists, and require just a little more wood than handles and musical instruments. A large amount of wood is used in the manufacture of pumps and wood pipes. Canes, umbrella handles, brooms, firearms, artificial limbs, and tobacco pipes, use large quantities of wood.

Taken all in all, Uncle Sam's lumber industry is a big item. If we add to the above the immense quantities used for firewood and railroad ties, we then begin to have an adequate idea of the vast extent of this industry.

NUMBER AND VALUE OF FARM ANIMALS.

The latest computation of the number of milch cows and their value on the farms of the United States on February 1, 1914, as given by the estimates of the Department of Agriculture, are as follows:

The estimates indicate that the number of milch cows on farms in the United States is now 20,737,000, an increase of about one-half of one per cent. over the census figures of 1910. Meanwhile the average farm price of milch cows has increased from $35.79 in 1910 to $53.94, or an increase of 50.7%. On this basis the farm value of milch cows now in the United States is estimated at $1,118,487,000 as compared with an estimated value in the census year of $738,184,000, an increase of $380,303,000, or an average annual increase for four years of $95,075,000.

The average value of milk sold by farmers in the United States was $0.087 per gallon in 1899 and $0.130 per gallon in 1909. The average value of cream per gallon in 1899 was $0.43, and in 1909, $0.69. The average value of butter per pound in 1899 was $0.17, and in 1909, $0.24. The average value of cheese per pound in 1899 was $0.09, and in 1909, $0.12.

The quantity of butter made on farms and in factories in 1900 was 1,491,752,602 pounds, and in 1910, 1,619,415,263 pounds. The quantity of cheese made on farms and in factories in 1900 was 298,344,642 pounds, and in 1910, 320,532,181 pounds.

COMPARATIVE VALUE OF THE CATTLE ON FARMS FOR THE CENSUS OF 1910 AND 1900.

The value of all cattle, including cows, on the farms for the census of 1910, is estimated at $1,499,523,607, showing an average value of $24.26 per head. The same values for 1900 are $1,475,204,633, showing an average value of $21.78 per head. Thus, while the number of cattle decreased, the value slightly increased. Allowing for the discrepancies in the dates of taking the two censuses and for the classification of different ages, the census report comes to the conclusion that had the census of 1910 been taken on June first, after more spring cows had been born, the average value of cattle reported would have been somewhat lower, because of the great increase in the number of these calves of low average value. Allowing for this discrepancy, the total valuations per head would have been brought a little closer together.

In regard to the total value of dairy cows, the data for 1910 show a total of $706,236,307, or an average of $34.24 a head. For 1900 the data show a valuation of $508,616,501, or an average of $29.68 per head. Thus the average value of dairy cattle per head increased from 1900 to 1910, despite the fact that the average age of the class was doubtless somewhat lower at the later census than at the earlier census. It is interesting to note, also, that the average number of cattle of all kinds per farm was 14.3 head in 1900 and 11.7 head in 1910. These data show, also, the progressive decrease of cattle, not only with the population but also with the average number on the farms.

In regard to other animals on the farms, the census shows the following comparative data:

	1900	1910
Number of horses	18,267,020	19,833,113
Number of mules	3,264,615	4,209,769
Number of asses and burros....	94,165	105,698
Number of swine	62,868,041	58,185,676
Number of sheep	61,503,712	52,447,861
Number of goats	1,870,599	2,915,125

These data show an increase in the number of horses during the ten years, of 8.6 per cent.; in the number of mules, 29 per cent.; in the number of asses and burros, 12.2 per cent.; and a decrease in swine, of 7.4 per cent.; in sheep, of 14.7 per cent.; and an increase in goats of 55.8 per cent. In regard to the values of the animals, the following comparative data are given: Total value of the above-named domestic animals on the farm in 1900, $2,979,197,586; in 1910, $4,760,-060,093. The increase of the value in the ten years amounts to 59.8 per cent. of all animals. The increase by classes amounts to 1.6 per cent. in cattle; 132.4 per cent. in horses; 167.8 per cent. in mules; 127.1 per cent. in asses and burros; 72.1 per cent. in swine; 36.8 per cent. in sheep; and 89.1 per cent. in goats. For all domestic animals the average increase in value in the ten years was 59.8 per cent. The average value per head for the animals named other than cattle, which has already been given, is as follows:

	1900	1910
For horses	$49.08	105.06
For mules	60.11	124.80
For asses and burros	61.71	124.89
For swine	3.69	6.86
For sheep	2.77	4.44
For goats	1.75	2.12

The comparisons are modified slightly, as in the case of cattle, by the different dates at which the census was taken, namely, June 1st for 1900 and April 15th for 1910. Had both censuses been taken on June first there would probably have been much less decrease in the number of cattle and sheep, a moderate increase in the number of swine, and a somewhat greater increase in the number of horses and of mules, than is shown in the table.

As regards the value of the different classes of domestic animals, horses led in the census of 1910, showing 43.8 per cent. of the total value of all the classes combined. On the contrary, in 1900 the value of cattle greatly exceeded that of horses; but the value of cattle per head increased only slightly during the decade, while that of horses more than doubled. Horses, mules, asses and burros together contributed more than one-half, namely, 55.1 per cent. of the value of domestic animals on farms in 1910; while cattle alone contributed almost one-half of the total value in 1900, namely, 49.5 per cent., and in 1910 the cattle contributed only 31.5 per cent. of the total value.

The above data show that while meat producing animals, namely, cattle, swine and sheep, decreased in number in the decade from 1900 to 1910, other animals, namely, horses, mules and asses, increased in number. The increase in number, however, in mules was the only one in which the percentage of increase exceeded the percentage of increase in the rate of population, the mules increasing 29 per cent., while the population increased only 21 per cent.

From the data contained in the 13th census we learn that there are in the farms of the United States 878,798,325 acres, of which 478,451,750 acres are improved, and 400,346,575 acres unimproved. I shall endeavor to show that by a proper application of the principles of scientific agriculture, now well understood, we can easily support one person on each 2 acres of the actual arable land in this country, or a total of nearly 300,000,000 souls. The total area of Belgium is 7,278,720 acres, and its population 6,410,783, or nearly one for each acre. Ohio resembles Belgium in contour, climate and fertility of soil. Ohio has an area of 26,131,200 acres of land, and, measured by the Belgium standard, could easily feed 20,000,000 people. Ohio is only an example of what other portions of the United States could do.

It would be too much of detail to give here all the agricultural products of the vast area of our lands. It is enough to know that with the present method of farming the quantity of food and clothing produced is far greater than is needed by the 100,000,000 people now within our borders. When Uncle Sam's big farm is properly cultivated, we would not be hungry with a population equal to that of China, Malthus and Sir William Crookes to the contrary notwithstanding.

XXX

A TRIBUTE TO SQUANTO[1]

SPECULATIONS concerning the origin and destiny of man have always been a favorite pastime of philosophers and theologians. If man really had his origin in all the ways which have been seriously and facetiously described the difference in races and individuals are no longer a matter of wonder. If at the end the race be disposed of in harmony with the several notions relating to his destiny the future state of man will not be open to the charge of monotony.

The theme of this discourse is far less pretentious than the scope of discussion outlined above. It accepts man as he is without a question as to his origin. It dismisses him finally without predictions as to his future state. As becomes a theme suggested by the dedication of a building devoted to Agriculture, it is of the earth earthy: The wings of fancy which might carry the poet into ether are changed into plodding feet which never lose touch with the ground.

But the toes, as is also becoming, are pointed to the coming years, but not so far advanced as to prevent the heels from being buttressed against the solid facts of the past. The true value of vaticination is vastly increased by adhesion to verity. My prophetic eye to-day, therefore, peers into the depths of another cen-

[1] An address delivered at the inauguration of the agricultural building of the State University of Ohio, at Columbus, on January 12, 1898.

JEREMIAH RUSK
Secretary of Agriculture, 1889-1893
Under whose administration the Department of Agriculture started its active campaign in support of agricultural education

tury, not to catch the glint of marching bayonets, nor to hear the sound of forensic eloquence. Nor does it look across the sea to trace the progress of events on that ground where nearly all history has been made. On the contrary, it scans only our own land, and for the sole purpose of ascertaining, in a modest way, how Agriculture is to feed the three hundred million mouths that will be opened for food in these United States on the good day of our Lord Jan. 1, 2000. Every college boy who has advanced to his senior year is familiar with the leading theories of so-called economic science on this subject. It is quite surprising with what accuracy the comfortable college professor sets limits to the number of our inhabitants and the products of agriculture. The alluring theories of Adam Smith and Malthus have never lost their dominant influence in those cozy libraries where the well fed professor, with his gastric glands in full function on a good dinner, tells us of the near starvation of man. Our virgin soils, he says, are exhausted. The average of field crops is decreasing. This country has reached its maximum limit in the production of food stuffs. In a few years we will be importing meat and bread. The increase in our population will soon be checked by the limits of subsistence. Every energy of man will be used up in the struggle for existence. Progress will be arrested, and humanity having reached its full flower and fruit, will soon enter upon that era of retrogression which is the natural course of all human events.

Such are the dicta of the lecture room and of the magazine.

I do not believe that this pessimistic view of the near future of man is based on fact, nor sustained by tenable theory. In support of this statement, I propose to discuss very briefly some of the relations of the new agriculture to the sustenance and welfare of man.

THE NATIONS NOT TO STARVE.

In a short space I shall try to show how the scientific agriculture of the future will easily provide for all the demands which a rapidly increasing population will make upon it. In the illustration of this statement I shall refer only to a few of our staple products, and first of all, wheat. The adage "Bread is the staff of life" should not be taken too literally, but in a more diffused sense, bread represents especially the cereal crops. Among these wheat is second in quantity, and first in its importance as a direct human food. Our average product of wheat for a period of ten years is 12.7 bushels per acre. This rate of production is practically a minimum. It is what the patient soil will produce under a régime of chronic robbery. The average production of wheat for a period of 50 years in a soil at Rothamsted which has never received a particle of manure during the time specified, is 13½ bushels per acre. A part of the same field, properly manured with barnyard manure, has given an average yield of 33½ bushels per acre.

INCREASED YIELD OF WHEAT.

I have before me a bulletin of the Maryland Agricultural Station which gives a yield of wheat obtained on plots under proper culture in Prince George's County, Maryland. I find that this soil, which a few years ago was regarded as worthless for agricultural purposes, has yielded, under scientific management, 40 bushels of wheat per acre. This is not a chance harvest, but one that has been often obtained, and one that can be obtained indefinitely.

The methods which are employed for securing these yields are well known. They can be easily and generally applied, being changed to suit changed conditions of soil and climate. With intelligence and care, such as the agricultural stations and colleges make possible to every farmer, these full harvests can be generally obtained. Thus, without adding anything to our present acreage, it is easily possible to increase our wheat yield three-fold. Scientific agriculture to-day may safely undertake the task of feeding 240,000,000 Americans, and exporting 150,000,000 bushels of wheat without encroaching upon the area now devoted to any other crop.

INCREASED YIELD OF CORN.

But wheat is only a small part of our resources. Indian corn is almost as nutritious as wheat. Its content of protein matter is not gluten, and it does not make light and spongy loaves, but it does make bread, highly nutritious and palatable. The average yield of Indian corn for the past ten years in this country has been 24.2 bushels per acre.

When I turn to the reports of the Kentucky experiment station I find a most striking lesson. We usually think of experiment stations as the helpers of the poor soils, but in the case of Kentucky we find one situated in the heart of the great blue-grass region, one of the most fertile agricultural areas in the world. Chemistry, however, revealed the fact that this soil was poor in potash. When this cheap fertilizer is applied to the land we see at once the striking effects which the simple application of well-known scientific truths produces. The year 1889 was one in which the climatic conditions were well suited to the production of Indian corn. In that year the yield on the Kentucky experiment station, on land to which no fertilizer was applied, was 31 bushels per acre. The yield on a portion of the same field which received muriate of potash at the rate of 160 pounds, and nitrate of soda at the rate of 160 pounds per acre, was 87 bushels. Thus, by the application of 320 pounds of fertilizing material per acre, half of which was obtained at a very low price, the yield of Indian corn was more than doubled. This illustration, it is true, represents an extreme case, that is, one in which the climatic conditions were especially favorable.[1] But one of the great triumphs of scientific agriculture in the future will be found in the more practical control of climatic conditions than is at present secured. We will be able, on the one hand, to conserve the natural moisture so that the effects of dry seasons in diminishing a crop will be reduced to the minimum. On the other hand, we will be able to so control large excesses of precipitation that the sinister effects of an excessively wet season will likewise be reduced to a minimum.

In respect of temperature, there is little reason to fear, inasmuch as the average mean temperature of the growing season does not vary greatly in any period of years.

THERE IS MORE THAN GRAIN IN INDIAN CORN.

We have spoken only of the grain of Indian corn, and in this is not included more than half of the true

[1] In recent years a few boys in corn clubs of the country have attained officially certified yields of over 200 bushels of Indian Corn per acre.

value of this marvelous plant, the discovery of which was almost as important as that of the American continent itself.

Profligate nature stores in the stalks of the Indian corn a greater quantity of food than she deposits in the grain. Only lately have the experiment stations shown the high food value of the dry stalks, millions of tons of which are annually burned on the vast plains of our maize belt. The value of the dry stalks alone for cattle food is nearly as great as that of the ear. But in the fresh stalk are found large quantities of sugar, one of the best fattening foods in the world.

At the time the grains of the ear are fully formed and firm, but before they are dry, the stalk contains its maximum amount of sugar, fully 12 per cent. of its weight. For every average acre in maize, 3000 pounds of sugar are produced. In the natural drying of the stalk, in autumn, this sugar ferments and is distilled into the air, Nature's proof spirits, both of the sunshine and moonshine stills, although ungaged and unstamped by any collector of inland revenue. No wonder our friends in Iowa are such strict Prohibitionists, since they may, on any warm day in October after a heavy frost, drink into their lungs in Nature's big saloon rich draughts of this prairie dew.

Mixed with a small ration of cotton seed or flax seed cake, or with beans or peas, this waste sugar of the maize fields would fatten every steer, pig and lamb in the country, and there would be enough left over to feed all the cattle, horses and sheep of the whole world. With all this wealth of material available, what need have we to tremble before the bogy men of Malthus and his disciples.

IMPROVEMENT IN QUALITY.

I have spoken of the possibilities of increasing the yield of our staple crops and consequently of increasing, almost indefinitely, the sources of human food. There is another important line of progress along which scientific agriculture will help in this work. I refer to the methods by means of which the character of a crop or of an animal may be changed by scientific selection.

A hundred years ago the ordinary garden beet contained only from 3 to 5 per cent. of sugar. To-day the sugar beet, which has been developed from this primitive form, contains 15 per cent. of sugar. In seven years of scientific agriculture, the Department of Agriculture raised the average content of sugar in sorghum from 9 to 14 per cent. Practically nothing has been done along this line with other standard crops, but it is perfectly certain that the character of any crop can be changed, almost at will, in accordance with the demands which may be made upon it. The protein content of wheat is now 12 per cent. It is safe to predict that a few years of careful scientific selection would increase this content to 15 per cent.

There is no time here to even mention the details of the work by means of which this desirable result can be accomplished. Protein matter is by far the most costly, pound for pound, of human food, with the possible exception of oils and fats. There is such an illimitable field of progress before us in the production of carbohydrates for foods that we look with interest upon any methods which may be devised for increasing the content of protein matter in such standard crops as our cereals. In other words, we may be able to accomplish with all of our standard vegetable crops what has already been accomplished in the development of a dairy cow or a race horse. Thus not only do we see the prospect of increasing crops for a given area, but also of adapting the character of these crops more particularly for the purposes to which they are to be devoted.

ECONOMY IN STOCK FEEDING.

In the methods of using foods also great progress has been made and greater still is to be expected. It is possible, with the information which we now possess, to put a pig of a given weight on the market at only about two-thirds of the expense that formerly attended this process. By a careful study of the character of the food, it is possible to balance the rations in such a way that each type of food exercises its maximum nutritive properties. This has already been accomplished, to a large extent, in the farmyard and it is possible to apply similar principles also in the dining-room. Just as a chain is as weak as its weakest link, so a food is as poor as its poorest typical element. In the proper balancing of the rations, and in the appropriate mechanical preparation and in the cooking of the food large economies can be effected and the progress and welfare of the race promoted.

According to our present system of grazing and feeding, from two to three acres of land are required for the sustenance of a dairy cow, while in the grazing or range section of the West the area is much larger. Last summer, I had the pleasure of seeing a method of green feeding practised by the Minnesota experiment station, in which it was demonstrated that a cow or a sheep could be kept on practically one-fourth of the area above described. It was remarkable to see in evidence before us the animal living and flourishing on an area which was so small as to seem almost impossible. Yet this simple experiment has demonstrated what can be done in a scientific way in increasing the number of food animals which can be sustained on a given area of land. Having shown how our product of the cereals may be easily doubled or increased threefold on a given area of land, it is interesting to note that it has also been demonstrated by scientific agriculture how the number of food animals sustained on a given area can also be increased two- or threefold. Thus it is not only bread which we are to furnish, but also the meat, which will be forthcoming in proper quantities.

PROGRESS NOT CONFINED TO ARABLE SOILS.

Of the vast area of our arid regions we need not wholly despair. According to conservative and competent authorities, it is estimated that with the visible supply of water at least 5 per cent. of this region may be subjected to irrigation. This area alone would add immense stores to our granaries. On irrigated lands it already pays to practise intensive agriculture. Extensive agriculture will not pay on land which it has cost $50 or more per acre to reclaim and prepare for the seed. At the present time one acre of irrigated land means as much as three of ordinary land in furnishing agricultural products.

The coming triumphs in agricultural science will not be confined to our present arable soils. The arid wilderness is to be conquered, and even the snows be robbed of their terror. When the surface water has been used up the inexhaustible subterranean streams still remain. The very blizzards that sweep down upon us from the far Northwest will be harnessed and made, by the medium of electricity, to furnish us with heat and light.

The superficial changes which man will make in the cold and arid regions cannot fail to produce a profound impression on the rainfall. Forests will rise to check the fury of the northwest winds, and to change the physical condition of the soil and subsoil. The tamed elements of nature will be pressed into service, and in the end, help along with the work which they at first so strenuously opposed. We may not be able to bring back those tropic breezes which lured the megatherium and the pterodactyl to linger about the boreal regions in those times:

"When the sea rolled its fathomless billows
Across the broad plains of Nebraska,
When around the North Pole grew bananas and willows,
And mastodons fought with the fierce armadillos
For the pineapples grown in Alaska:"

But as in the future we shall laugh at the lack of moisture, so shall we mock the snow and the blizzard.

It requires only a simple calculation by an electrical engineer to show that if all the energy of the winter's northwest winds were converted into heat by means of windmills and dynamos, the North Dakota farmer in January might be seen mopping his brow vigorously, and fanning himself as he trimmed his orange trees.

We have also practically inexhaustible sources of heat close beneath the surface of the earth. The frost never penetrates more than a few feet below the surface. At a comparatively small depth a summer temperature is reached. It is entirely probable that man may draw upon the interior of the earth for supplies of heat for warming his habitation and growing his green vegetables under cover in winter.

EXTENDING THE BOUNDS OF TILLAGE.

There are good reasons, therefore, for believing that both in respect of moisture and temperature, the agricultural science of the future may open up large areas to tillage that are now abandoned to desolation and to frost. Even in Alaska we read accounts of gardens and fields of cereals and of meadows for grazing cattle. In the recovery and utilization of waste products the farmer of the future has spread before him a field of richest promise. It has been shown that with proper culture and feeding the yields of our fields may be increased threefold. Scientific feeding of animals is yet a new science, but it has already shown how to put beef and pork in the market at less than two-thirds of the cost of 50 years ago. The science of man feeding is only in its primer. The science of field feeding is still learning its alphabet.

From the streets and sewers of cities, from the deserts of Chili and Arizona, from the islands of the Pacific and from the oceans and seas the future farmer will draw the food to feed his fields.

In the geologic ages of the distant past, before the dawn even of primitive agriculture, provident nature garnered the migratory elements of plant food in stores whose extent and richness are yet but little known. In the case of potash, only one locality in the whole world has been exploited, and that only partially. But even in the deposits of Stassfurt and vicinity are found stores of potash which our successors at the end of a thousand years may freely draw on. The conditions which determine the deposits of potash in that locality are not unique, and there is every reason for believing that others equally extensive will be discovered. The decomposing granites and other potash-bearing rocks are affording over wide areas additional stores of this food, so eagerly eaten by plants, and so necessary to the formation of carbohydrates, one of the principal foods of animals.

The stores of nitrate of soda on the Pacific coast of South America show no signs of exhaustion. In the arid basins of southern California and Arizona are found large deposits of soils containing from 5 to 20 per cent. of nitrates. These deposits have been formed in past ages of the earth from the decay of marine vegetation and animal remains. Deposits of guano are formed chiefly from the dèbris of birds, mostly of marine predatory habits. In the little frequented islands of the Hawaiian group these deposits are now forming, as is shown in photographs I have lately seen, in which large areas are completely covered with birds and their eggs.

NOTHING IS HOPELESSLY LOST.

The bones of marine and terrestrial animals, man included, are never wholly lost to agriculture. In this country alone are found deposits of phosphates in South Carolina, Florida, Pennsylvania and Tennessee, large enough to feed our crops for many millenniums. Thus the three most essential plant foods, namely, phosphoric acid, potash and nitrogen, are stored on every hand in forms not obnoxious to decay, and in places accessible to man.

> There is no death, only atomic changing,
> When life from one form to another passes,
> And new life comes but from the rearranging
> Of the old parts in new atomic masses.

The sea, the miser of the vanished ages,
Gives up its cherished dead to weed and coral,
And from the tombs of heroes and of sages
Spring fields of corn and fragrant beauties floral.

The dust of Cæsar, through the centuries sifting,
Will reach new life, and feel the thrill of being;
No grave so deep, the storied shaft uplifting,
As darkened eye to keep again from seeing.

The very bread, which you to-day are eating,
Has passed from earliest æons through life's phases,
The circle of eternal life completing,
Secure, untouched, through all its mystic mazes.

The sea is the final receptacle of the plant food, which seems to be hopelessly lost. The rain dissolves and carries away the elements which escape absorption by the plant. The streams and rivers finally carry these precious stores into the ocean, where they, to the thoughtless observer, are forever hidden. But not so. The sea is the great conserver and sorter. Nothing which enters these apparently unfathomable depths escapes attention. Mineral substances of like nature are brought together and deposited in layers of various thicknesses, which subsequent changes of level in the earth's crust render available. Sea weeds and algæ seize on the soluble portions of this waste of matter and fix them in their tissues. Afterwards this vegetable matter serves for the nourishment of marine animal life, or is cast upon the shore, and becomes directly useful to man for the fertilizing principles it contains. Marine animal life feeds on other stores of waste matter, and converts them into forms suitable for food for man and for fertilizing purposes. Vast stores of oil, human food, nitrogenous and phosphatic fertilizers are thus rescued annually from the depths of the sea.

NOT MUCH PROMISE FROM SYNTHETIC FOODS.

I have not considered at all in this relation the possibility of producing foods and other agricultural products by direct synthesis in chemical laboratories. We must realize the fact that chemistry has made great advances in this direction within the last few years. The chasm between the organic and the inorganic has been completely bridged over, and it is possible now for the chemist to commence with inorganic materials and to proceed step by step until he is able to form from them true organic compounds. In this way alcohols, sugars and glycerids have already been produced, and the chemist of to-day is attacking vigorously the problem of building up compounds as complicated as the proteins. I am not a believer, however, in the possibility of chemistry ever displacing agriculture and forming from the inorganic elements all the food necessary for man and beast. Lately, in an address before the American Chemical Society, in Boylston Hall of Harvard University, I reviewed this whole subject, and it is not necessary now to do more than refer to it. In that address I said:

"According to Berthelot, the fields which are now defaced by agriculture will be beautified by regaining their natural covering and the earth will be one vast park of pleasure and the chemist the great conservator of the human race.

"In all the instances brought forth there is not the slightest approach to anything to justify the prophecy of a period of artificial food. The few cases of synthesis in which the products approach the composition of anything digestible present such insurmountable difficulties in expense and supervision as to render any expectation of reaching economic results utterly futile. In the great majority of cases, as has been seen, the process of synthesis is conducted on materials already organized by living cells. The enormous cost of building up any kind of a commercial, synthetic organic body directly from the elements is such as to render it, in my opinion, utterly improbable of successful achievement.

"Even if food products can be formed in the crucible there is no reason whatever for supposing that they can ever play any rôle in an economic sense. The untold billions of laboratories which nature builds are infinitely cheaper in construction and operation than those filled with platinum and porcelain. The sun ignites the crucibles of nature at an expense far less than attends the use of the city gas works. The director of Nature's laboratory depends on no endowment nor legislation for his salary and his bills for supplies are not disallowed by any board of auditors on the score of economy. Night and day his patient, faithful assistants work without thirst for fame, without hope of reward. They fight not for priority of discovery, and their anonymous papers are printed in rich profusion in the great Berichte of the universe. The chemistry of the chlorophyl cell is far more wonderful than any of the achievements of Lavoisier, Berzelius, or Fischer.

"It would doubtless be a solace to the weary toiler in the sun to look forward to a time when he might lie in the shade while proteins were pricking up their ears in the condenser and fats frying in the scientific pan. But in the days of the far future, while Berthelot will still be honored, and Fischer praised, the farmer will be found following in the furrow, fields of waving grain will brighten the landscape, and herds of kine graze upon the hills."

FRUITS OF AGRICULTURAL EDUCATION.

The agricultural colleges and experiment stations point out the way and demonstrate the practical methods to be pursued in converting extensive into intensive agriculture. The work of these great factors in political economy is still in its infancy. The era of accomplishment is hardly inaugurated. We are now only in the midst of preparation for the advance which is to come. To teach the art of conserving and utilizing to the best possible effect all the sources of supply — that is the glorious future of agricultural education and experiment. The progress of humanity is not a breeder of poverty, but of wealth. For every additional mouth are provided two additional hands. The human race is not a Polyphemus, blinded by the wandering Ulysses of education, and doomed to a hopeless struggle in the dark. Clear of vision, firm of purpose, it pushes on to its final destiny. Depending wholly on agriculture for subsistence, it looks to the field for that future support which will bear it on in greater achievements. The more dense the population, the greater the happiness, the greater the progress of the race. It is not work in the field that has caused our agricultural population to contribute so large a percentage to the inmates of our insane asylums; it is isolation. Scientific agriculture will bring men closer together. It will make the village, and not the isolated farm house, the center of residence. It will turn Ohio into a Belgium, with 20,000,000 people within her borders, not slaves to ignorant labor, but beneficiaries of enlightened agriculture, which will bring plenty to the granary, ease to the evening of labor, and refinement to the parlors of the poor. It will show the absurdity of the Malthusian myth, and the speciousness of the Georgian pessimism. Our people are not going to starve. The mission of the new building this day dedicated to agriculture will not be in vain.

FORGET NOT THE HUMBLE BEGINNING.

On the threshold of this new birth of progress and of possibility it is meet that we should not forget the humble beginnings of things. Monuments and memorials are rising to Liebig, to Berthelot, to Gilbert, to Morrill and to Hatch. We mention with gratitude the names of Storer, of Johnson, of Caldwell and of Hilgard, and we gladly join in every acclaim of the services which they and many others have rendered to the cause of agriculture. But there is still one to whom we owe a debt, and whose name is never heard, a true and typical American, whose majestic figure we may never see in bronze and marble. Some 300 years ago he stood on the shores of Massachusetts Bay, where the eager east wind, as now, often made life a burden. The sturdy white men, lately transplanted from over the sea, were not looked on with much favor by many of his brethren. His philanthropy, however, went out to them, and it was he who, in those early days, taught our ancestors the first principles of scientific agriculture. He laid the foundations of that system of experiment which is the basis on which our agricultural colleges and experiment stations of to-day stand. Listen to the simple record of his work:

A DESERT WHICH MIGHT BE IRRIGATED

MEAGER MENTION OF SQUANTO.

The honor of teaching the American colonists the use of artificial fertilizers belongs, without doubt, to an Indian named Squanto. In Governor Bradford's "History of Plimouth Plantation" is given an account of the early agricultural experiences of the Plymouth colonists. In April, 1621, at the close of the first long dreary winter "they (as many as were able) began to plant their corne, in which service Squanto (an Indian) stood them in great stead, showing them both ye manner how to set it, and after how to dress and tend it. Also he tould them, axcepte they got fish and set with it (in these old grounds) it would come to nothing; and he showed them yt in ye middle of Aprill, they should have store enough come up ye brooke by which they begane to build and taught them how to take it."

Another account mentioned by Goode of the practice of the Indians in this respect may be found in George Mourt's "Relation or Journal of the Beginning and Proceedings of the English Plantation settled at Plimouth in New England, by certain English Adventurers, both merchants and others, London, 1622." "We set the last spring some twenty acres of Indian corn, and sowed some six acres of barley and pease, and, according to the manner of the Indians, we manured our ground with herrings, or rather shads, which we have in great abundance and take with great ease at our doors. Our corn did prove well, and God be praised, we had a good increase of Indian corn, and our barley indifferent good."

Thomas Morton, in his "New England Canaan," London, 1632, wrote of Virginia: "There is a fish (by some called shadds, by some, allizes) that at the spring of the yeare passe up the rivers to spawn in the pond, and are taken in such multitudes in every river that hath a pond at the end that the inhabitants doung their ground with them. You may see in one township a hundred acres together, set with these fish, every acre taking 1000 of them, and an acre thus dressed will produce and yield so much corn as three acres without fish; and (least any Virginea man would infere hereupon that the ground of New England was barren, because they use more fish in setting their corne, I desire them to be remembered, the cause is plaine in Virginea) they have it not to sett. But this practice is only for the Indian maize (which must be set by hand), not for English grain; and this is, therefore, a commodity there."

We look back to-day, therefore, three centuries to the very beginnings of American agriculture. To that dusky bronze figure, proud in the simplicity of his fortune, let us to-day turn our eyes. For that service which he rendered the struggling pilgrim, and for that example of scientific agriculture let us to-day bring this tardy tribute to Squanto.

THE END

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